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Porsche

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Trust the process

The undisputed benefits of real-time track engineering

Testing racecars with a capable driver at a nice track is, mostly, a great joy. We call the process track engineering the racecar, even though it excludes much of what we generally understand by the term engineering, and includes all sorts of other, far less objective factors.

Calculating the most adequate aero settings using simulation software is clear-cut engineering, but physically selecting cambers and tyre pressures on a live racecar is often very distant from a maths equation. When track temperature changes then push you to adapt the set-up, it often becomes, in all honesty, a guess. All of us with many years' experience in the field can attest to this, having felt it when something works very well in a March test at one track, then fails to show the same result in a hot summer test at another.

If we were to replicate those same tests, in similar conditions but with two different drivers, we would probably get very different outcomes and comments again. The variations are endless, making it impossible to stay fixed within the mathematics.

Importance list

In Dallara's R&D office, we used to discuss a kind of 'importance list'. It told us which items on the car, subject to set-up changes, had the biggest effect on lap time; ultimately, the only judge of your job. The list had four levels, and the first included parameters such as weight, engine power, aerodynamic efficiency and tyres. I will spare you the rest of this otherwise interesting, but still very useful list.

There was another list that parted items from others: which ones affected things like balance, handling and so on. Next to consider was when a certain balance or handling change had a significant impact on lap time.

Last on the 'mental process' leading to the chosen set-up change was a consideration for the type of driver we had in the car.

Crucial for the track engineer is to have a clear picture in mind of all these factors and considerations. You guessed it, probably half comes down to pure engineering decisions, while the rest is pleasing the driver, trying to make the tyres last longer or trying to improve this or that without being 100 per cent sure of the effect – on that particular day, at that track and during that session.

A competitive reference lap time is therefore a very useful thing to have. You may have a driver telling you the car feels good, and reacts as they like it, while you note that they are half a second away from a really competitive time under the given conditions. You would be in trouble if it was qualifying.

Track testing is always useful, but getting it right is not easy with variable conditions, and successful tests rely on developing a good relationship between driver and engineer

On a test day, you have the opportunity and, hopefully, the time to be a bit more adventurous. Add an extra click of rear damper rebound, or a degree of front flap. Go for a radically softer car in roll, a stiffer car in vertical spring rates and lower the car, or take the differential out for a radical change.

I used to say that the differential lock and the dampers have something in common: you need them, and you need to fine tune them, but mostly you want to try to have just enough, while avoiding too much, because they both consume power through increased friction and heat dissipation.

Very often, that principle works fine, but there are days, or circumstances, when it fails to deliver. It can be down to the track, but usually it is tyre-related. I never liked hearing people say, 'These tyres are rubbish at combining lateral with longitudinal loading.' I think it's close to nonsense. Certainly, a driver can quickly get this impression when comparing different tyre makes, or types, but it is the 'lesser' tyre that does everything with less talent, causing that simplistic impression. The right set-up changes will vastly improve the situation. You'll notice the driver won't repeat the same comment.

Making good better

I recently experienced this situation once more. I was convinced that this 'good' car, driven by an excellent driver, was not fast enough. I told him that with a certain change, I expected him to drive more aggressively into the corners. I told him the car would be much more stable under braking, which should invite pushing it faster into the corners. Although he had previously been telling me he was pleased with the car, when he came back in after the set-up change, he had a great smile on his face: 'I like this a lot,' was his glowing verdict. 'It feels like another dimension of the car has awaken.'

His comments on balance and handling were similar to those given earlier in the day, but he was braking later and entering faster into all types of corners. The result? We had just found that 'hidden' half a second.

Told you. Testing *can* be a great joy!

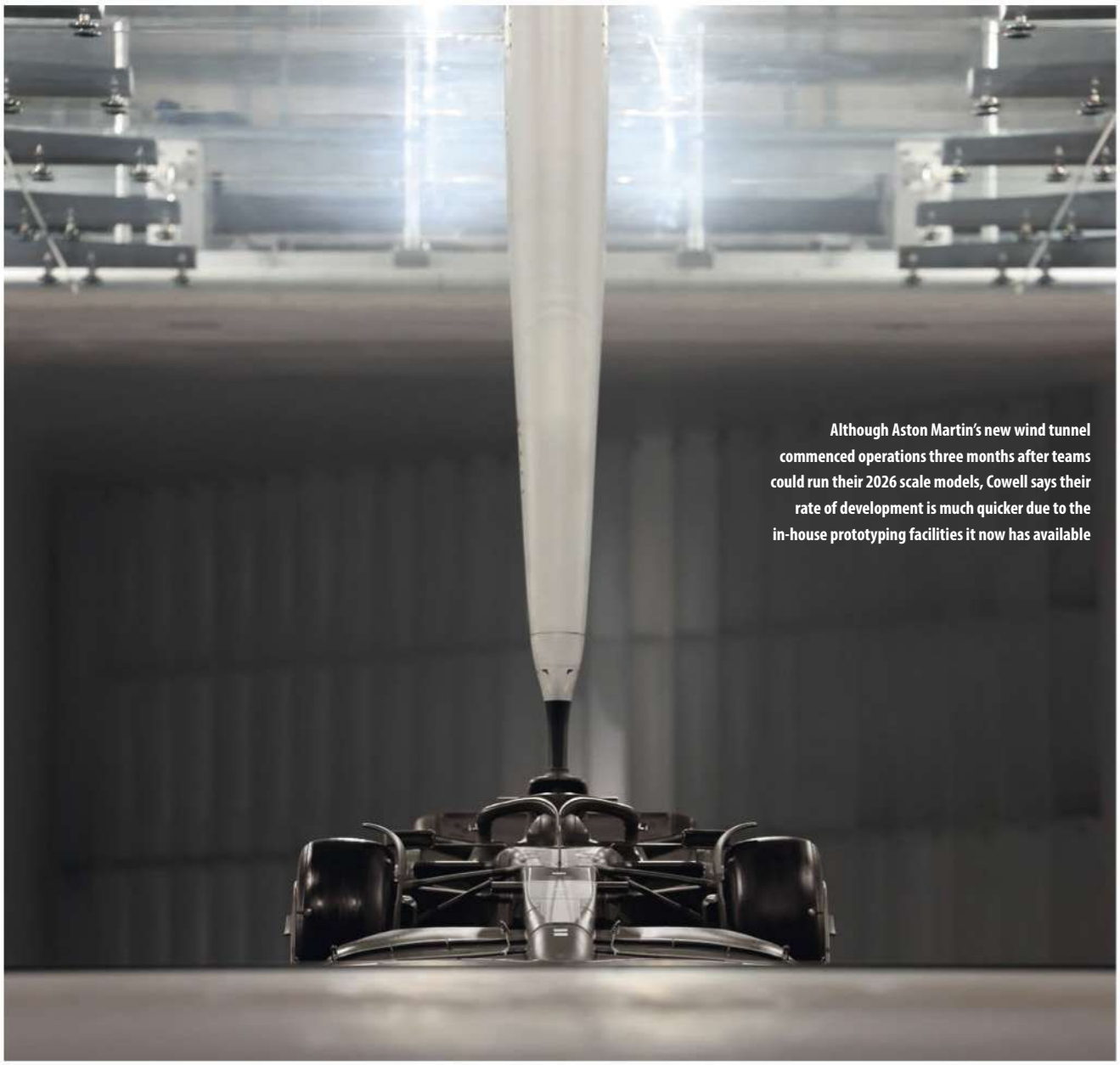
On a test day, you have the opportunity and, hopefully, the time to be a bit more adventurous

In the works

Aston Martin's Andy Cowell explains how the team is transitioning from customer to works team ahead of 2026

By DANIEL LLOYD

After five years as a Mercedes customer, Aston Martin is embarking on a works power unit programme with Honda



Although Aston Martin's new wind tunnel commenced operations three months after teams could run their 2026 scale models, Cowell says their rate of development is much quicker due to the in-house prototyping facilities it now has available

At a basic level, there are two main types of race team in professional motorsport: works and customer. The works team runs the cars that it builds, while the customer, or privateer, team runs cars it has purchased from the manufacturer. There have also been many examples throughout the sport's history of semi-works or 'satellite' privateer teams benefiting from different amounts of manufacturer input.

In modern Formula 1, the distinction between a works and customer team is mainly based on what power unit (PU) the car is using. This is because all teams manufacture parts in-house to varying degrees; some depend on external suppliers more than others, such as Haas, which outsources its chassis manufacturing to Dallara.

McLaren, the reigning World Constructors' Champion, builds its own chassis but is a power unit customer of Mercedes, yet it's difficult to call the Woking outfit a privateer based on its level of in-house expertise. Therefore, F1 is an environment where the traditional definitions of works and customer / privateer team are not always met.

Andy Cowell has now been with Aston Martin for over a year, and has overseen the team's gradual attainment of greater autonomy over its activities

New direction

Another example for the semanticists to pore over is Aston Martin, which since its rebranding from Racing Point in 2021 has paid Mercedes to supply its PU, gearbox and rear suspension package. However, in 2026, the Silverstone-based team will take a new direction, aligning with Honda to develop a new PU for the fresh regulations. It is an exclusive arrangement; Honda is not providing its forthcoming 1.6-litre, turbo-hybrid V6 to any other team, so the unit is being designed purposely for the Aston Martin chassis and platform.

Although Honda is not yet ready to lay bare the details of its 2026 engine project, Aston Martin is understood to have been feeding into the power unit's development,

The AMR Technology Campus has brought more of the team's activities under the same roof, although its works PU programme carries a more international medley of key parties

especially in terms of how it integrates with the chassis and cooling systems. The partnership also involves the introduction to F1 of a new fuel supplier in Aramco, where the Mercedes customer PU ran on Petronas.

Add to that the adjustment to a sparkling new factory containing lots of new toys, as well as the hiring of several star engineers, including Adrian Newey and Enrico Cardile, and the scale of Aston Martin's move away from being a straightforward PU customer quickly becomes apparent.

'It's a big change going from a customer team to a works team,' says Andy Cowell, team principal at Aston Martin Formula 1 Team. 'Buying the power unit, the ERS, the transmission, the [rear] suspension and the uprights from Mercedes means the aero surfaces you can put over all that are controlled by the solids underneath.'

Cowell knows what it takes for a works team operation to succeed. The British engineer, who started with Aston Martin in October 2024, previously led Mercedes-AMG High Performance Powertrains (HPP) and was at the helm when it propelled the German company's works team to eight consecutive Constructors' titles between 2014 and 2021. Cowell is therefore acutely aware of the benefits and freedoms a bespoke power unit can bring to a race team, even if it is typically a more resource-intensive exercise.

'[Mercedes] have provided well to this team for many years,' he says, 'but going forwards, [in] the working relationship with Honda, absolutely everything on the front of the power unit is designed in conjunction with the rear of the chassis – and the same on the interface between the rear of the engine and the front of the transmission. All of that is considered very carefully with the direction the aerodynamicists want to take with the external shape of the racecar and sidepods. It provides the opportunity to fully control the aerodynamic surfaces and cooling configurations.'

Aston Martin announced Honda as its works power unit partner in May 2023, almost three years before their first race together. It signalled a swift return to F1 for the Japanese company, which officially left the sport after the 2021 season. However, to this day, it has maintained an involvement with the Red Bull and Racing Bulls teams that had been using its PUs through a service support arrangement. So there has been chronological overlap between its Red Bull association and its 2026 project with Aston.

'[We are] working in partnership with Honda on performance sensitivities from a cooling / aerodynamic perspective, hand in glove with them on their performance sensitivities,' says Cowell. '[And] bringing all that together and collaborating as we create the AMR26 means that it's all in Honda and Aston Martin Formula 1 team's destiny.'

That working partnership has entailed various decisions about how to approach the new rule set, which features a higher proportion of electrical energy and regeneration from the MGU-K, and a new aerodynamics package with less emphasis on ground effect.

'It's very simple to say, in one sentence, that we're going from customer to works,' suggests Cowell, 'but works involves a big shopping list of complex projects.'

Transmission transition

One of the biggest such projects during Aston Martin's transition has been the creation of a bespoke gearbox. F1's technical regulations state which parts a customer team may buy in from another competitor, such as the power unit, gearbox and rear suspension. These are known as transferable components, or TRC. Most transmission components are TRC, such as the gearbox casing (including carrier, fastenings and heat shields), internals, the clutch assembly and actuation system, and ancillary parts including oil pressure and scavenge pumps, oil filter and differential actuator. Whereas Aston Martin previously bought these sorts of components from Mercedes, it now must make the full list itself.

'The working relationship with Honda… provides the opportunity that you fully control the aerodynamic surfaces and cooling configurations'

Andy Cowell, team principal at Aston Martin F1 Team

The F1 team known today as Aston Martin has undergone various identities since its 1991 grand prix debut as Jordan. The Silverstone squad has also been known as Midland, Spyker, Force India and Racing Point, but hasn't developed a bespoke transmission since 2008. It amounts to a considerable loss of in-house expertise that has needed to be reclaimed over the last two and a half years.

'It's a big undertaking across the whole value stream map, from engineers to metallurgists, the design work, the simulation work,' Cowell summarises. '[It requires] a different supply chain and quality control and installing a transmission test dyno. It takes control engineers and technicians to run the dyno and people to plan that whole journey. Getting [the transmission] to work with seamless shifts, with the amount of power a Formula 1 car puts out, and within the tight aerodynamic constraints, is no mean feat. The attention to detail and quality control, and thoroughness of testing that's going on there, is immense.'

Aston Martin's F1 gearbox dyno has now been up and running for over a year. Testing began with prototype models and has slowly ramped up through different iterations that more closely resemble the final product.

'With each version, there are issues,' explains Cowell, 'so there needs to be updates to components. Sometimes that's modifying existing [components], sometimes that's an all-new design. We have been on that journey with a dedicated team for well over 12 months.'

Global venture

Transmission dyno running has also taken place at Sakura in Japan, Honda's research lab where it is developing the hybrid power unit. Although Aston Martin has brought more of its operations in-house to a new factory, such as installing its own wind tunnel, making new pit equipment and developing more software, the works team exists on a wider geographical scale than the customer set up. Mercedes was a short blast up the A43 road to Brixworth, but now it's an intercontinental exercise (although Honda does have a UK-based centre for servicing F1 power units).

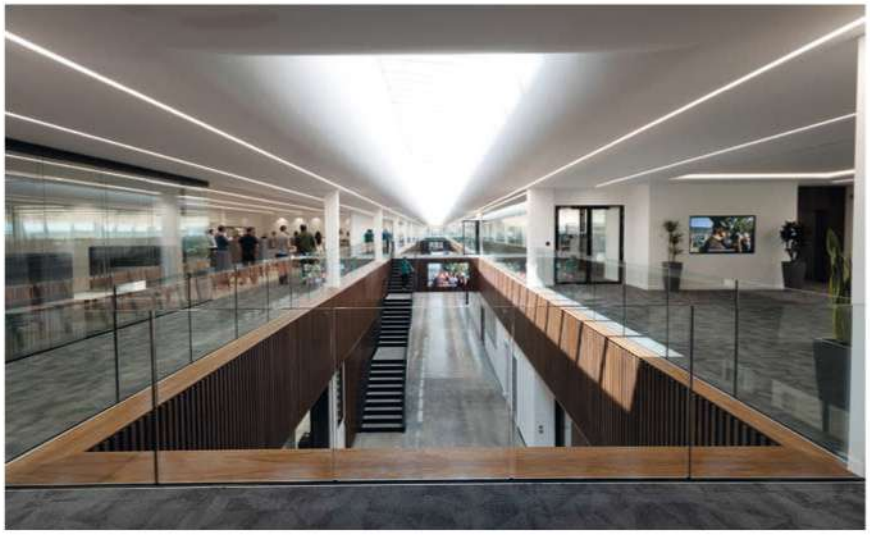
There is also Aramco, the Saudi Arabian state-owned oil company, which has its fuel research and development centre in Paris, and Kentucky-based Valvoline, which is providing bespoke lubricants for the PU and transmission. At time of writing, Honda is yet to transport the power unit to Silverstone for integration with the chassis, but Aston has undertaken plenty of simulations to prepare for it. While the internal combustion engine and hybrid system are being built in Japan, the gearbox is being manufactured in the UK, enabling Aston Martin to correspondingly design the rear suspension mounting points.

'One thing you definitely learn with experience is that you need to test things thoroughly, because you won't get every single calculation, simulation and assumption correct,' says Cowell. 'There will be errors, there will be lack of understanding. You've got to test thoroughly within the test cell environment, getting a prototype transmission together as early as possible. Also, for that whole supply chain to get experience of inspecting precision-ground components, cleanliness standards of build areas, quality control of build. The test environment needs to be commissioned before you can start testing. So, proving that the test environment actually measures torque correctly, and controls all temperatures well, cooling everything to the right precision level. It is not a trivial journey.'

Breeze frame

The move away from being a customer team is more than the easily definable development of a bespoke transmission. It is one part of a broader expansion project that team executive chairman, Lawrence Stroll, hopes will culminate in silverware.

Aston Martin's glistening Technology Campus is a three-building leviathan, covering 37,000m^2. It opened its doors in July 2023 and has been gradually unwrapped in stages. The last building to be completed, building three, contains a new wind tunnel. The obvious benefit to this is that Aston no longer needs to truck its 60 per cent scale model to Mercedes for every physical aero run, which brought risks of miscorrelation and necessitated working around Mercedes' own test schedule. The new tunnel was completed before the end of 2024 and, after a period of calibration, commenced operations as the team's nominated facility in March 2025. All the 2026 car's wind tunnel testing has taken place since then, in the new tunnel.

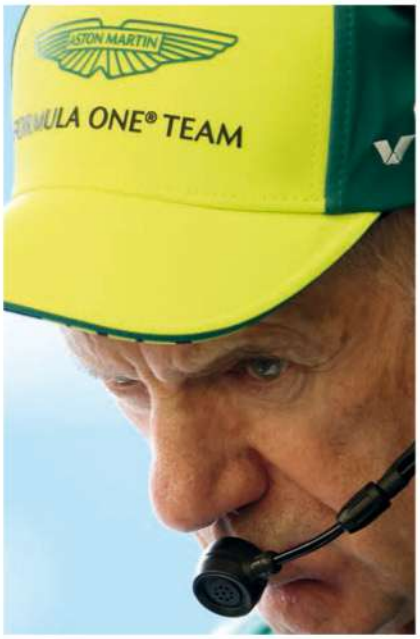


Cowell says the AMR Technology Campus has an 'open plan' feel, enabling key decisions to be made at a rapid pace

Aston Martin is growing rapidly in terms of in-house engineering, testing and simulation capabilities, including a new driver-in-the-loop simulator

Teams were able to start wind tunnel testing their 2026 designs from 2 January 2025. Despite that, Cowell says the new facility has permitted an 'increased pace' of development compared to when Aston rented out the Mercedes tunnel. This is helped by having additive manufacturing stations and a build area for the scale model, enabling different prototype parts to be realised and tested quickly.

'When we were doing the commissioning work, we were making sure the measurement accuracy was on a par with our expectations,' says Cowell. 'Since then, we have improved the accuracy and added further technology. That's not just the tunnel. Everybody asks about the wind tunnel, but it's also about the model. The technology that sits beneath the aerodynamic clothes is highly complex, with exceptionally intricate, precise technology.



Decorated designer, Adrian Newey, started working with the team in March this year, while new CTO, Enrico Cardile, joined the operation in the summer

The development of that has continued at pace, as well as the development of the wind tunnel measurement, which is exciting to see because it enables the aerodynamicists to have a better visualisation of what is happening with the flow fields across the car.'

Dream team

Aston Martin is growing rapidly in terms of in-house engineering, testing and simulation capabilities, including a new driver-in-the-loop simulator. But such advanced systems are only worth the investment if they are used wisely and produce tangible results. This is partly why Stroll and his upper management have assembled a supergroup of senior designers and engineers in the quest to win titles. The roster reads like a dream team of technically minded F1 talent: Newey (formerly Red Bull) as managing technical partner, Cardile (ex-Ferrari) as chief technical officer

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and Bob Bell (previously Enstone) as executive director – technical. Not to mention Cowell himself, whose CV is one of the most decorated in the paddock.

Just how does Aston Martin get the most out of such esteemed individuals, to avoid a 'golden generation' scenario where their individual merits struggle to coalesce and inhibit the overall team performance? Establishing clarity in the structure is part of Cowell's job to ensure that doesn't happen.

'The addition of Adrian has added a wealth of experience and a high-performance focus mentality,' he says. 'He is inextricably at the centre of the aerodynamic architecture and development of the car. Bob Bell has got a wealth of experience on the leadership, organisation, clarity of roles and responsibilities. Enrico has got a similar wealth of experience, with a strong bias in the aerodynamic field.'

Going further, Cardile reports to Newey and Cowell, and oversees the various teams responsible for designing different aspects of the car and improving performance. His job is, essentially, to make decisions based on the findings of each specialist team. The Italian was previously Ferrari's chassis technical director and started in his CTO role with Aston Martin this summer.

'We're trying to find the best way of collaborating, and blending our efforts, rather than working in silos,' says Cardile. 'This is key for us – and for any F1 team: sharing information, creating something that's richer than the sum of the parts. It's certainly not a problem having all of these good engineers in the same building, working together.'

Cowell describes his role as being about linking the business together. One of his favourite analogies is to imagine a relay team of athletes running a marathon in 100m segments, with each one completing their leg in under 10 seconds and with perfect baton changes. Aside from conjuring amusing images of F1 engineers as sprinters, it illustrates the level at which Cowell wants the team to be operating.

Innovation rate

'How do you make sure the whole business provides a good environment for every single engineer, such that our innovation rate is high?' he suggests. 'That, for me, is a key thing. How do we make sure that our innovation of development rate is steeper than any of our opponents, chasing performance quickly, but robustly? That requires a big emphasis on excellence: getting things right first time, so you don't have to go around it twice.

'I see my role very much in that sphere of making sure everybody is lined up beautifully, so that if Adrian comes up with an idea, the results come back quickly. The same for when we release to the full-size world, rather than the 60 per cent wind tunnel world. I think we've all got clear roles, crucial responsibilities. We're very fortunate that we're working in a campus with an open-plan environment, so *ad hoc* conversations can happen when thoughts and observations come into our heads. The pace with which we can make change and adapt is high.'

In the current ground-effect era, which comes to a close at the end of this season, Aston Martin twice finished fifth in the Constructors' standings. Its best campaign occurred in 2023, when Fernando Alonso claimed eight grand prix podiums

'This is key for us – and for any F1 team: sharing information, creating something that's richer than the sum of the parts. It's certainly not a problem having all of these good engineers in the same building, working together'

Enrico Cardile, chief technical officer at Aston Martin F1 Team

However, the big name, big money signings only scratch the surface of Aston Martin's wider shift. Cowell says 250 people have joined the team in the last 12 months, although stresses that number can't be taken as a net increase because it also covers the normal ins and outs of a large organisation. Notably, Aston Martin has been advertising for Japanese-speaking trackside engineers, to help reinforce the bond with Honda.

Cowell describes Silverstone as having 'a significant increase in the number of people so we can control things ourselves, instead of outsourcing engineering and operational activities. We control the speed, the flexibility and the quality of what we're pursuing.'

When we catch up with Cowell in early October, it is a few days shy of his one-year anniversary at the team. He began his tenure in the role of chief executive officer but, at the start of 2025, was appointed team principal, following a re-shuffle that saw his predecessor, Mike Krack, move to a trackside engineering post.

Ready for action

'There's been significant change,' says Cowell, reflecting on his first 12 months, which were a critical time for the team's 2026 planning activities. 'It was this time last year that the last two buildings were completed, and the commissioning of the wind tunnel and driver-in the-loop simulator started. A year ago, there were big openings, big transitions of people moving around.'

That movement has stabilised more recently as Aston Martin's debut as a team using a works power unit draws nearer. It is impossible at this stage to say if it will be a fruitful collaboration, and there are likely to be many factors influencing the pecking order on the grid at the start of the 2026 season. But the least Aston Martin can do is put the tools in place to give itself the best chance of becoming the team to beat.

'The objective is to come up with championship-winning racecars, which is quite a transformation for the team from its origins,' says Cowell. '[In previous iterations] the measure of success at the end of the year was that the business was still alive. That [Force India] team punched well above its weight, but the transition to having the budget, the facilities and the genuine ambition to win, is quite a mental change. It's a huge change in the targets that are set and the approach that's taken.'

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Turning up to 11

The debut of the first new F1 team in a decade is fast approaching. Racecar *was given an exclusive, behind-the-scenes look at its preparations*

By DANIEL LLOYD

It is rare for a new Formula 1 team to be created from scratch. The last time it happened was in 2016, when Haas entered the fray. Another 'recent' one is Mercedes in 2010, although it was continuing an existing lineage of teams based in Brackley. Many 'new' teams have joined in this way, superseding a predecessor and assuming their existing infrastructure, but the creation of a completely fresh team from scratch is an extraordinary occurrence.

Like Haas, Cadillac is an American entity, although its ethos is different. The General Motors brand will, in time, become a chassis and power unit manufacturer – a fully works team – whereas Haas has remained a customer team, closely wedded to its power unit supplier, Ferrari. Haas joined the championship with impeccable timing, one year before Liberty Media acquired F1 and set off a boom in its American popularity that now incorporates three Stateside grands prix. Cadillac, on the other hand, is joining a party that has already started, with a view to benefiting from, and sustaining it.

Mammoth task

It has been a mammoth task to get the championship's 11th team up and running, in time for the 2026 season. All the fundamentals we take for granted when thinking about other teams had to be put in place: locations, machinery, people. Cadillac will be an American F1 team, operating from a new campus in Fishers, Indiana where the chassis will eventually be built. The power unit, meanwhile, will be developed at General Motors Performance Power Units (GM PPU) in Concord, North Carolina.

As a presence in the UK's Motorsport Valley is essential, due to the proximity of parts suppliers and F1's logistical operation, a forward base at Silverstone will be responsible for turning around in-season updates and running the race team. At the start of the upcoming season, Silverstone will have a more prominent role because Fishers is still being fitted out, and nothing will be manufactured there until approximately late summer 2026. Silverstone is, therefore, the place to glean the most tangible insight into Cadillac's preparations for its debut.

In mid-October, the team granted *Racecar* an exclusive tour of the site with its chief technical officer, Nick Chester, a former Enstone stalwart with senior engineering experience at Renault and Lotus. After stints with Mercedes and McLaren in Formula E, Chester is back in F1, playing a central role in driving Cadillac's technical direction.

Silverstone site

'We started off in Banbury, in a really tiny office with about five of us,' recalls Chester. 'We then moved to the Silverstone Sports Engineering Hub and took one office. That was up to 20 [people]. Since then, it has grown and grown and is evolving all the time. Most people are quite used to moving desks.'

Cadillac will be an American F1 team, operating from a new campus in Fishers, Indiana where the chassis will eventually be built. The power unit, meanwhile, will be developed at GM PPU in Concord, North Carolina

'Getting the departments living together is a really big advantage'

Nick Chester, chief technical officer at Cadillac Formula 1 Team

From the outside, Cadillac's Silverstone HQ looks like any of the other red-trimmed, grey metal warehouses in the area, but inside, a new F1 team is growing

In one corner of one vast warehouse, piles of race equipment are stacked ready for shipping out to the grand prix circuit

Formula 1 and the FIA officially announced Cadillac's entry in March 2025, almost exactly one year before its race debut. Once its place was confirmed, the team ramped up its recruitment drive, although the foundations had been laid at least two years prior when Andretti Global was leading the bid, before any formal approval was given.

Chester says the team has gone from about 180 people at the start of this year to 400, and is expected to reach 450 by the beginning of 2026. The Silverstone site will eventually top out at 600 people, with around half on the technical side (excluding operations and production). Once Fishers is online, the manufacturing team there will consist of around 200 staff, plus non-engineering roles.

In total, Cadillac's UK facility takes up six buildings of an industrial park directly across the road from the Silverstone racetrack. It is relatively inconspicuous, at least compared to Aston Martin's new megastructure a few blocks away, but it's what's inside that counts.

Grand tour

The largest building, 1136, covers some 8300m^2, though only a section is currently being used, to house the aerodynamicists. It will eventually contain all desk-based technical departments – aerodynamics, design, vehicle performance and strategy – on a grand mezzanine. Around 400 people will call this their place of work. More hands-on activities such as component testing and validation, car build and electronics will be on the ground floor of the same building, once the outfitting work is completed in late summer 2026.

The vision is to promote quick decision making by establishing cohesion between the departments. Cadillac F1 team principal,

Silverstone's focus will be on agility, prototyping parts and rolling them out to meet shorter, more frequent deadlines

Graeme Lowdon, has previously spoken of a NASA-inspired management system where conversations between departments happen horizontally, rather than vertically.

'We didn't want a company where people felt they needed approval for everything, going up and down the chain,' explains Chester. 'When we started out with five or six of us, the department heads were sat together. As we've grown, that lateral communication has stayed strong and is something we really want to keep.'

Referring to the main building at Silverstone, he continues, 'All the departments will either be sat next to each other, or in some cases intermingling. Say we're doing a front wing development, we'll have the front wing designers sat with front wing aero, sat with the supply chain. And they'll treat it as a project. That just means we'll get there faster, because we're not waiting for aero to come up with something and design then saying, that won't work, have another go.'

Several Enstone alumni have been drawn to the Cadillac project, such as Chester, Pat Symonds (executive engineering consultant) and Rob White (chief operations officer). That has helped to mould the way in which the new team goes about its work.

'I think at Enstone one of the problems we had when I was there – and I know it changed in later years – was that aero lived in the wind tunnel building and design lived in the main building, so it was always a bit of a communication problem,' reflects Chester. 'That's why getting the departments living together is a really big advantage. As soon as people can't walk 10-20ft to talk to somebody else, they don't bother. And email is rubbish compared to a face-to-face conversation.'

Power unit play

Until GM's own power unit is ready, the Cadillac team will use customer PUs from Ferrari. However, it won't take the full list of parts available to it. For example, Cadillac is doing its own gearbox carrier and rear suspension for 2026. Why is that?

'With it being new regulations, there were some parts Ferrari wanted to supply but were going to struggle to have ready in time, because they're working to the latest date they can for their own car,' explains Chester. 'And there were other parts we wanted to be able to look after ourselves. So, it's a bit of a mixture.'

Though the Cadillac facility was under construction at the time of our visit, it's already busy, with wind tunnel models on the benches

Chief technical officer, Nick Chester, brings with him a wealth of engineering experience from time spent with Arrows, Renault and Lotus in F1, as well as in Formula E

Currently, Cadillac is leaning on external suppliers for many parts, including the chassis, which are being brought to Silverstone for assembly and integration ahead of the 2026 season.

'It's all our design, but we're working with a supplier in the UK to manufacture it,' confirms Chester. 'The same for quite a few other components. Over time, those components will be made at Fishers, and the front wings and floors will be made here.'

Essentially, Fishers will be where larger scale manufacturing projects take place, for parts that only need rolling out once or twice a year. Silverstone's focus will be on agility, prototyping parts and rolling them out to meet shorter, more frequent deadlines. As Fishers gets up and running, Cadillac's

The site consists of six buildings and is constantly evolving. In addition to those described, there is one for HR, IT, electronics and executive offices, plus a further building housing partnerships, marketing and finance

Part of building 1136 is currently occupied by the team's aero office, but will eventually contain all desk-based technical departments

dependence on external suppliers will gradually recede to make way for greater levels of in-house production.

In time, the team plans to manufacture its own chassis, as would be expected from a works outfit. However, the timing of that is dependent on the future of the power unit regulations. It is currently unclear how long the V6 turbo-hybrid formula will last, with the FIA considering a return to V8s in the early 2030s. General Motors is therefore facing a conundrum over which engine formula to prioritise. This has a knock-on effect regarding when it brings chassis production in-house, because the chassis needs to be designed to accommodate a particular PU.

'Depending on when [the future regulations] come in, it might affect which year we move chassis across,' says Chester. 'We're going to wait until we see how those regs drop out. That could change the year.'

Concord-based GM PPU is led by Russ O'Blenes, who was recently joined in the senior leadership roster by ex-Audi F1 CEO, Adam Baker, as chief operating officer, and former Ferrari consultant, David George, as director of power unit utilisation. According to Chester, that arm of the team is 'flat out' on understanding the 2026 formula, but is also 'doing a little bit of research' on V8 options.

'They have a similar task to us,' he adds, 'in that they are building the company and the facility while developing a V6.'

Preparation is key

Although Cadillac is dependent on suppliers for both its power unit and chassis, it is confident of hitting its key pre-season deadlines. In one corner of building 1501 (currently housing a model shop and pit equipment), a rig lies in wait for the final chassis to be delivered and tested to ensure FIA compliance. Chassis crash testing will take place before December, early enough to permit a re-test if something is amiss.

'We've got FIA homologation coming up,' outlines Chester. 'After that, in December, we've got a fire-up here. That will be the first time we fit a power unit. Then, we'll go to the Ferrari four-wheel dyno before Christmas. We'll have a full power unit and gearbox for that. But we are going to do some trials at Maranello in November, just to ensure the gearbox cassette fits into the carrier, and then do some gearbox runs.'

Cadillac will use Ferrari's large-scale dynos until GM PPU obtains its own. The car's first shakedown is planned for January; the entire team is expected to be there, witnessing the first new F1 team in a decade come to life.

Next to the vacant chassis rig in building 1501 is a line of phone box-sized machines for testing the integrity of components. One is a tensile tester with a jaw-like grip that clamps a piece of metal and pulls it to verify its

Cadillac has also needed to assemble a race team from scratch, which involves hiring staff, purchasing equipment and establishing working practices

strength. The other half-dozen machines are hydraulic and more suited to repeated cycles. Another building houses a selection of new machining stations, including a range of DMG Mori CNC machines, five-axis mills, and lathes for turning. According to Chester, his technical team has sweeping approval from TWG, the project's investment machine, to spend on engineering where it sees fit.

Walking through the buildings, everything is clean and orderly, but it feels like the layout might change daily, depending on what's needed. One of the buildings, 1134, is split in half, with the right side off limits as the composites and prototyping (including wind tunnel model) departments are installed. The left side contains an inspection area with a new coordinate measuring machine, and a stores area stacked with blue plastic trays for organising small parts. These aren't really rooms, their boundaries are defined only by temporary dividers.

Currently, composites is tucked into the corner of another building and prototyping occupies what looks like an entrance space, with scale wind tunnel models of front wings looking a bit out of place on open benches. In a romantic way, it's refreshing to see, and hammers home the challenge of setting up an F1 team from scratch, even with the significant financial resources Cadillac enjoys. Chester reckons TWG and GM will have spent north of $100 million on the Silverstone facility once it's finished.

'The investment throughout is enormous,' he says. 'It's been so refreshing because TWG have just asked what we need. It's fantastic.'

Team effort

Developing an F1 car is only part of the task, albeit an important one. Cadillac also needs to assemble a race team from scratch, which involves hiring staff, purchasing equipment and establishing working practices. The scale of the middle point is made apparent by the sheer amount of stuff that occupies half of building 1134. In the centre, the team's pit box is laid out, while around it sits fireproof masks, gas canisters, gantry arms, pit wall stations and hundreds of TV screens. The team needs six sets of everything for the 24-round schedule. Everything is sat waiting to be sent off for sea freight in November.

While the team awaits delivery of its first chassis, race simulation has continued apace. Due to time constraints, not all rounds on the calendar have been simulated, but mock runs started with the Spanish GP and the team recently did its first two-car simulation

Drivers have been using the DiL simulator at GM's facility in Charlotte to prepare for real race weekends in 2026. To bring everyone up to speed, Cadillac has been going through the motions of a full race weekend, right down to scheduling media time for drivers

Adding people into the mix has been a challenge, because Cadillac doesn't yet have a complete chassis on which it can do pit stop practice. That is partly why it is leasing a car from a rival team in mid-November for a Testing of Previous Cars (TPC) session.

'We've got pit stop equipment over here, so we will be able to do pit stop practice fairly soon,' notes Chester. 'We're just finalising the control systems for it. We're going to have a single-corner rig that moves in and out so they can do single wheel [changes].'

To prepare, the team has been shadowing real grand prix weekends from the 2025 season, using GM's driver-in-the-loop (DiL) simulators in Charlotte, North Carolina. This involves running track sessions at the same time as the real event and mirroring other activities, even going as far as scheduling media time when the drivers are unavailable to the engineers. The mock runs started with the Spanish Grand Prix in May (Chester notes they stuck the car on pole, albeit with unrealistic ultra-high-grip settings – just for fun) and have gradually built up in complexity. At time of writing, the plan was for the Mexican GP to be Cadillac's first race weekend simulation with two cars. It hasn't shadowed every round for time management reasons, but has covered a sprint weekend.

'Everybody coming in for three days every race weekend would stop us from doing vehicle performance and tool development work on the new car,' says Chester.

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'We've scaled the schedule so it's broadly every two races. It's manageable, because we want to keep honing everybody's race weekend familiarity, but we also want to keep doing the bread and butter work.'

Simulation strategy

Cadillac uses GM's own DiL simulators in Charlotte for the build-up sessions, communicating between them and the desks at Silverstone. For race day, because it can't simulate the movements of other grand prix cars in real time, Cadillac picks a car from another team and runs its strategy based on that. A similar 'mission control' room will be fitted at Fishers, because the DiL simulator will eventually be located there, but not at the expense of Silverstone's mission control, each side supporting the other where necessary.

'The first simulation we did for Barcelona, we set a low bar in terms of expectations,' recalls Chester. 'It was actually a bit better than we thought. The biggest thing it highlighted was the communication side, which wasn't great. Now we've got the proper communication panels and headsets in, it's more immersive and has taken it on a step. You need to work how you'd work at the track.

'All the software tools have been improving. For recent race sims, we've gone as far as issuing set-up sheets to the mechanics with fuel levels and tyre sets. I'm sure it will still feel a step when it's suddenly real, but the whole thing has been about what can we prototype? In a way, we're prototyping going racing in here, but we've been prototyping chassis and other things for two years now.'

Transatlantic operation

Once mature, the Cadillac team will be based across three locations: Fishers, Concord and Silverstone. Ensuring all three are pulling in the same direction will be paramount, especially between the Fishers manufacturing centre and the Silverstone forward base for smaller parts production and integration. Central to this is physical interaction; Cadillac doesn't want to rely wholly on virtual meetings, as useful as they can be.

'We do want people to travel between the two sites,' highlights Chester. 'We're planning to train designers and technicians here and then have them go to Fishers. But also, to have some of our UK-based designers and technicians work in Fishers for periods. We want it to be quite fluid. You need that face-to-face interaction to make it work.'

When Fishers opens, Cadillac will become a true transatlantic constructor, though Chester says the upscaling of Fishers won't impact how the UK site evolves: 'We've got a transition plan. Because the production we're planning here for front wing, floor and model parts is building up, we're not expecting to do those things in Fishers. In Fishers, once we've [assembled] the 200-plus manufacturing team doing all the long lead time parts, that can build up separately. As that happens, we scale down some of our supply chain, but it doesn't affect what we're doing at Silvestone.'

Cadillac's wind tunnel testing will take place at Toyota Gazoo Racing Europe's facility in Cologne, Germany, but a good sized model design department will be located at Silverstone

While much of the focus is to ensure smooth cross-pond interaction, there is a third country involved in the Cadillac project. The team has been carrying out aero testing at Toyota Gazoo Racing Europe's (TGR-E) wind tunnel in Cologne, Germany. With McLaren now using its new in-house tunnel, Cadillac has exclusive use of the space, but is limited in how many runs it can do by the regulations. During our factory visit, laptops show a live stream of a scale wind tunnel model being put through its paces. The model was built in association with different suppliers to the chassis.

'It's never the same, run to run, because we're always fitting new parts,' says Chester. 'We've had two or three upgrades on it already, in terms of sensors and motion. We've had updates to the PIV systems, and we'll have our second new model in for December, which will be another technology upgrade. It's something we're keeping working on. We have a decent-sized model design department based [at Silverstone].'

Solid platform

The ideal in F1 is to have your own wind tunnel on-site, but that simply wasn't possible for Cadillac in the timeframe available. The options were, therefore, to either share with another team or use a third party. Chester reckons sharing with another team carries more disadvantages than going external because a start-up team needs as much testing time as possible.

'In the long term, we may look at doing our own tunnel, but it's not our biggest problem at the moment'

Nick Chester

'It's all manageable,' he says of the current arrangement. 'TGR-E have been very helpful to get us up and running. In the long term, we may look at doing our own tunnel, but it's not our biggest problem at the moment.'

The Cadillac team's debut is just around the corner. How it will fare is anybody's guess, but the scale of the challenge is universally appreciated. Yes, there is big backing from TWG and GM, but placing any expectation on a start-up when it comes to track results is risky business. There are some factors that might play to Cadillac's advantage, though. The onset of new regulations is a good time to join, as other teams are more likely to encounter design flaws that inhibit their cars' true potential. Cadillac has also been sensible with its 2026 car development, in terms of utilising suppliers rather than pushing to make everything in-house from the beginning. This could give it a better chance of having a solid platform on which to build than if it went 'fully works' straight away.

Further growth is coming, but every team has to start somewhere.

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From -47 per cent to -11.3 per cent: quantifying the path to closer racing

By JAVIER MAYORDOMO and ADRIAN VILLAR
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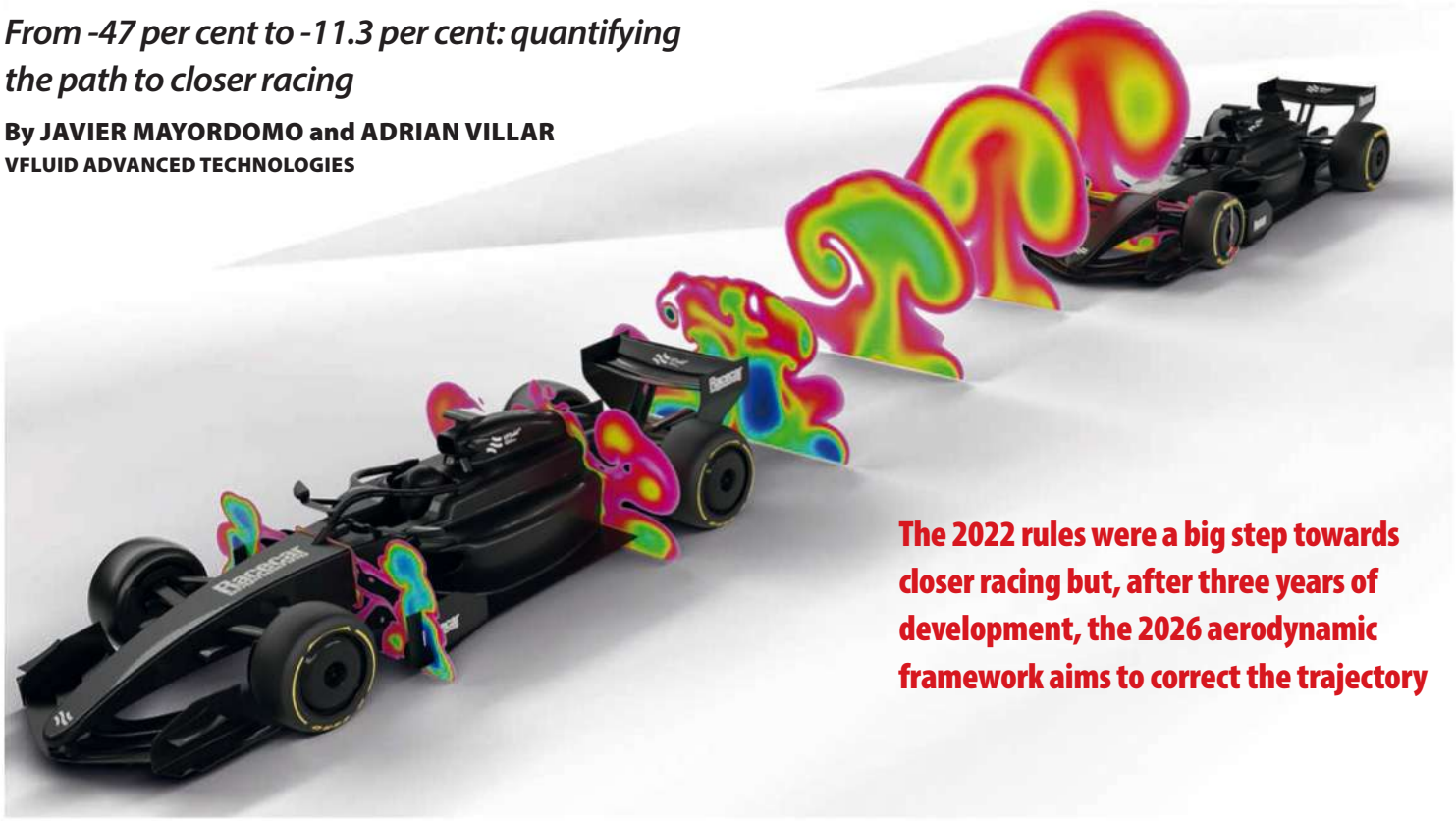

The 2022 rules were a big step towards closer racing but, after three years of development, the 2026 aerodynamic framework aims to correct the trajectory

Fig 1: Two-car CFD simulation of the proposed 2026 F1 cars showing wake evolution

A lack of overtaking, and races where the finishing order mirrors the starting grid, has been one of the main concerns for both Formula 1 fans and promoters in recent eras. During the period of extreme aerodynamic development, as thrilling as it was from an engineer's perspective, the problem became increasingly worrying.

It's well known that overtaking is virtually impossible at certain tracks. Monaco, for example, has earned a kind of mystique because passing is so rare, so anyone who pulls off a move earns respect across the grid. However, watching cars struggle to follow closely, failing to close the gap below 1.5s, even when clearly faster, and destroying tyres and cooling ability trying, became frustrating for fans and troublesome for the organisers.

Even with the use of DRS on the straights to create passing opportunities, audiences were becoming bored, and it proved harder to attract younger viewers who have become used to witnessing instantaneous action, all the time. Is a teenager today likely to sit through a two-hour grand prix, or will they by scrolling through TikTok videos by lap five?

When Liberty Media took over the commercial rights to Formula 1 in 2017, one of its first major technical campaigns was to address this issue. The result was the 2022 aerodynamic regulation overhaul. According to the FIA, over 7500 CFD runs and 16.5 million core hours were spent on defining a vehicle architecture that would enable closer racing, primarily by mitigating downforce loss in the wake.

Ground effect

This marked the return of a long-banned aerodynamic strategy – underfloor tunnels – and effectively marked a return to ground effect for the first time since the flat floor was mandated in 1983. Did all the effort pay off?

At the time the rules were introduced, F1's research estimated that a 2021-spec car could lose up to 47 per cent downforce at one car length behind (≈10m) and about 35 per cent at three car lengths (≈20m). The 2022 concept reduced that to an estimated 18 per cent at 10m and four per cent at 20m. In any race series, 10m is a huge gain, but especially when aero dominates modern F1, and drivers need every available bit of it to overtake.

Initially, the new regulations proved effective, though not immune to development. As with any rule book, engineers immediately started looking for performance within the grey areas, and teams found ways to claw back performance, at the expense of the following car. And of course, F1 teams are relentless, insatiably focused on maximising their own lap time. The effect on a rival's ability to follow is not a design objective. Why would any team make life easier for the car trying to pass them?

That's where the FIA steps in, and writes strict regulations limiting what teams can do.

The 2022 rules were a big step towards closer racing but, after three years of development, the 2026 aerodynamic framework aims to correct the trajectory once again, pushing even further to achieve sustained close racing, while anticipating the inevitable exploitation that comes with competitive engineering.

In this article, we evaluate how the 2026 aerodynamic rule package intends to achieve this goal, and present two-car CFD results from our in-house simulation campaign to quantify just how much the wake has evolved.

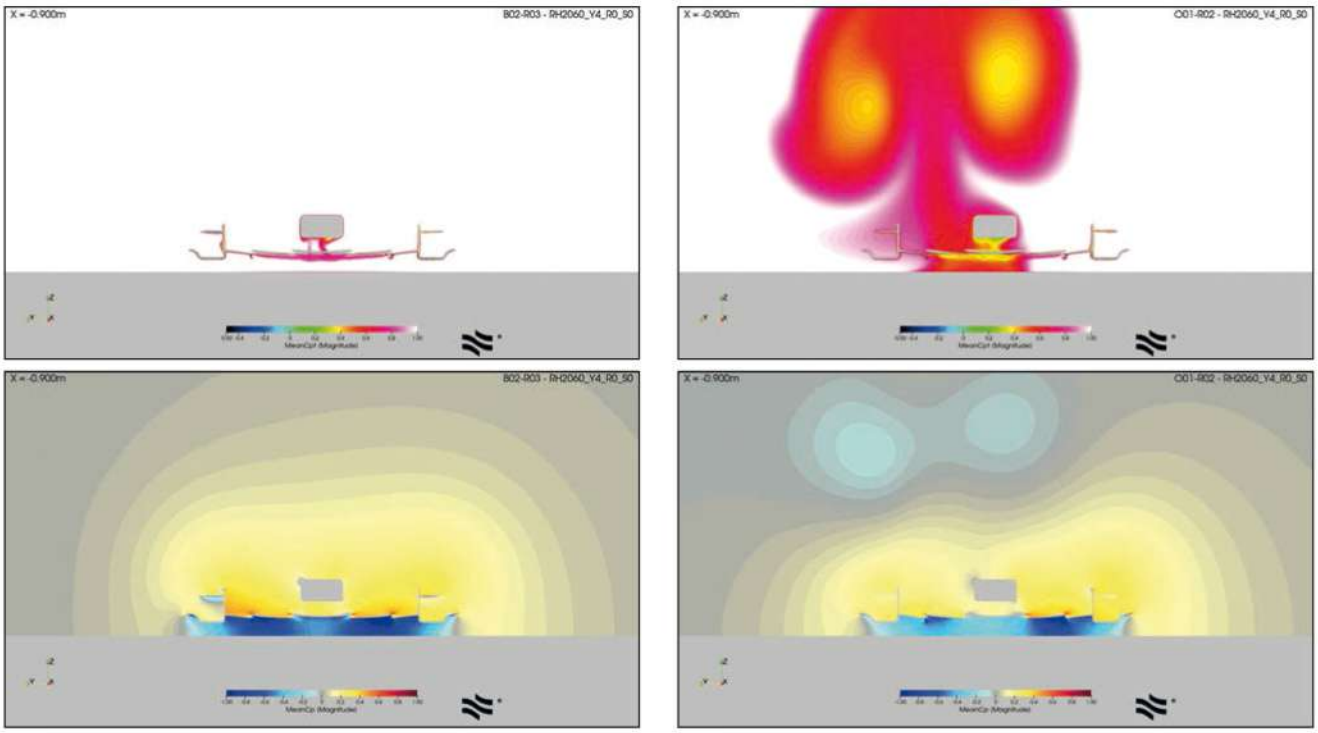

Fig 2: Total pressure coefficient (top) and total pressure (Cp) between freestream car (left) vs drafting car (right) at front wing X plane, where X = -0.9m

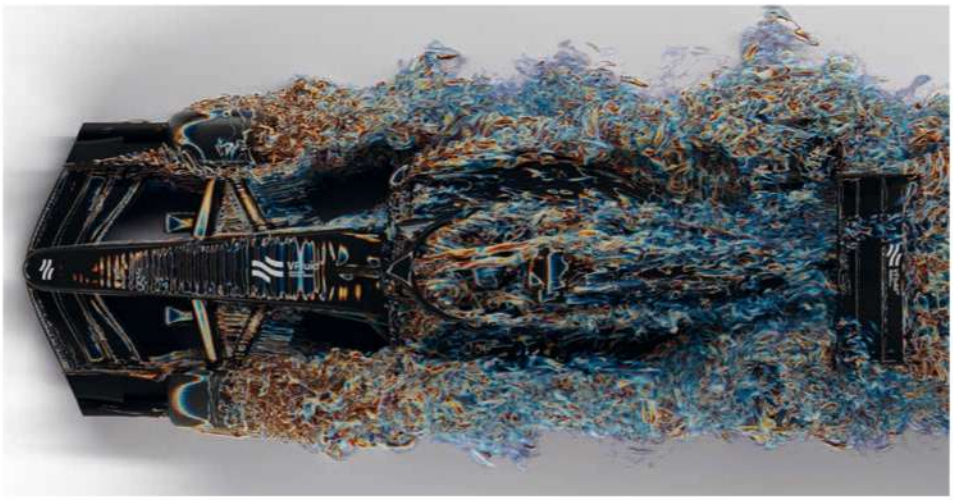

Fig 3: DES CFD simulation of 2026 F1 car

Air that has passed over, under and around the car is left in a disturbed, energy deficient state. The turbulent flow structure is a hostile environment for any aerodynamic surface that follows

So, just why does aerodynamic freedom tend to hinder close racing?

F1 cars operate in a regime where aerodynamic performance dominates overall lap time. To extract every millisecond, teams invest heavily in CFD, wind tunnel campaigns and on-track correlation work, all within strict limits imposed by the FIA to contain costs and preserve competitiveness. Despite these controls, aerodynamic development remains the most fertile area of performance gain.

Hostile environment

Downforce allows higher cornering speeds by increasing the normal load through aerodynamic means. However, this gain comes at a cost: the wake. Air that has passed over, under and around the car is left in a disturbed, energy deficient state. The turbulent flow structure is a hostile environment for any aerodynamic surface that follows.

The more aggressive the extraction of downforce, the more intense and chaotic the resulting wake. A following car that enters this zone of degraded flow sees an immediate reduction in its own aerodynamic load, particularly over the front wing and front axle. The closer it gets, the more it loses, making it progressively harder to close the gap. The losses are not uniform either. The front wing typically suffers more than the rear, so balance shifts towards understeer. Persisting in the wake with reduced downforce and growing understeer quickly translates into higher tyre degradation and brake temperature issues.

Moreover, operating in this condition leads to secondary penalties. Increased tyre slip accelerates degradation, while compromised cooling airflow raises thermal loads across brakes and power units. The performance loss compounds lap after lap, making sustained pressure and overtaking attempts difficult to maintain without external aids, such as DRS.

This fundamental aerodynamic interaction – the coupling of high downforce generation with high wake sensitivity – is what has historically made F1 resistant to close racing. Without intervention, the tools that enable lap time also act to preserve track position.

Outwash effect

So, what do grand prix teams do about this wake effect to help themselves? Exposed rotating tyres are among the most aerodynamically detrimental features of an open-wheel racecar. Acting as unshrouded bluff bodies, they shed broad wakes of turbulent, low-energy flow that not only generate significant drag, but also degrade the performance of downstream aerodynamic components.

In Formula 1, where every millimetre of surface is sculpted with aerodynamic intent, wake management is both a fundamental constraint and a performance opportunity

Fig 4: Total pressure coefficient (CpT) showing leading car wake propagation downstream

The front tyre wake can severely disrupt critical flow structures feeding bargeboards, floors and sidepods. Rear tyre wake, meanwhile, poses a direct threat to the diffuser's effectiveness, reducing underfloor performance and overall aero efficiency. In Formula 1, where every millimetre of surface is sculpted with aerodynamic intent, wake management is both a fundamental constraint and a performance opportunity.

To mitigate the effects of tyre-induced turbulence, teams have historically relied on an arsenal of devices. These include turning vanes, strakes, bargeboards and structures like the Y250 vortex. These were all engineered with one overriding objective: to generate outwash. That is, redirect the tyre wake laterally outward from the car body, maintaining clean airflow for downstream elements.

By pushing turbulent flow outboard, teams ensured that critical aerodynamic surfaces, such as the floor edges and diffuser inlets, operated in relatively undisturbed air, thereby maximising downforce and reducing drag. This basic philosophy underpinned much of the aerodynamic architecture on F1 cars from 2009 to 2021.

The drawback? While beneficial to the leading car, outwash broadens and lowers the wake footprint, leaving behind a wide corridor of chaotic, energy-deficient flow for the next car to contend with. Rather than encountering clean air, the following car enters a turbulent wake that drastically reduces its available downforce, particularly in cornering phases, making it much harder to follow closely.

The 2026 challenge

The challenge for the 2026 regulations is therefore twofold: to suppress the mechanisms that produce this wide, dirty wake, without entirely eliminating aerodynamic creativity. The FIA's response focuses on reshaping both the origin and trajectory of the wake, aiming to compress, elevate and realign the turbulent structures to facilitate multi-car racing.

So, how can this wake impact be controlled? And what regulatory changes have been introduced to achieve this?

To understand how the 2026 regulatory architecture affects the chasing car, we conducted a series of two-car CFD simulations using an in-house developed, 2026-spec model. The objective was twofold: to quantify the aerodynamic losses experienced by a following car in the wake, and to evaluate how those losses distribute across axles; an essential parameter for driver confidence and handling predictability.

We replicated the FIA's reference condition from 2022, that is a spacing of one car length (approximately 10m nose to nose). No yaw conditions were specified in the regulatory documentation, so we adopted a four-degree yaw for both vehicles to reflect realistic on-track alignment.

Balance shift

As **figure 5** demonstrates, our results show an 11.3 per cent drop in overall downforce coefficient (SCz) for the trailing car at 10m. That's markedly better than the -18 per cent figure published during the development of the 2022 regulations and suggests the 2026 aerodynamic configuration imposes a significantly less severe wake penalty at distances relevant to overtaking.

More critically, this loss is well balanced between front and rear. Aero balance shifts just 2.6 per cent rearward under wake conditions, well within the range drivers can

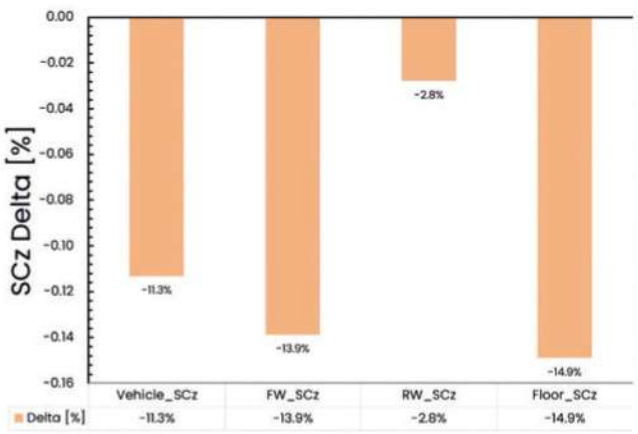

Fig 5: Graph showing relative downforce (SCz) loss per element

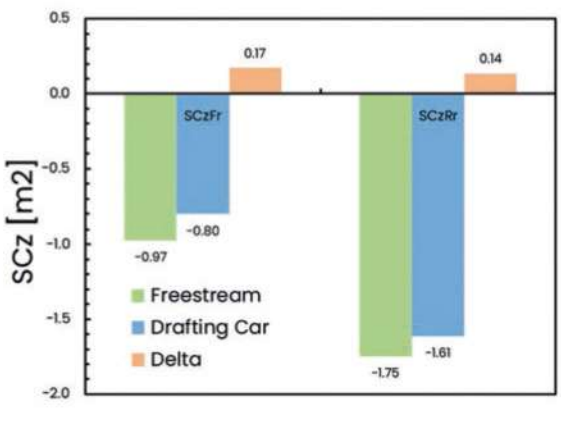

Fig 6: Graph showing front vs rear axle SCz drop

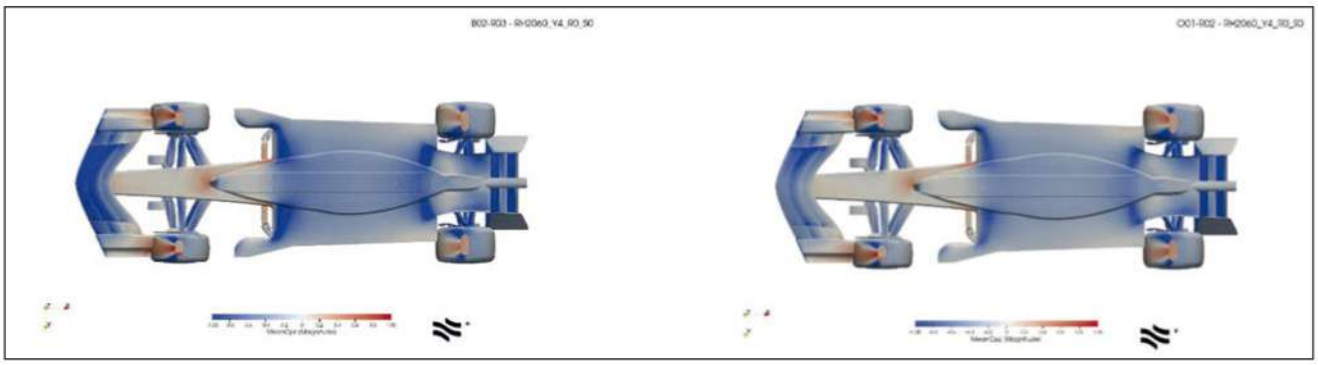

Fig 7: Downforce generation (CpZ) for freestream car (left) and drafting car (right)

manage without significant adaptation. This means the car remains predictable, with only a mild understeer tendency instead of the more disruptive balance migrations observed in prior regulatory eras.

The consistency of balance under load loss is not incidental. It is a direct consequence of design priorities embedded into the 2026 rulebook. How the new rules achieve this is by mitigating wake sensitivity.

One of the most effective ways to reduce the impact of wake turbulence is to reduce the absolute downforce levels across the grid. Lower downforce cars generate weaker wakes and are less penalised by partial downforce loss when following.

The FIA estimates a ~30 per cent downforce reduction in 2026 relative to current levels, largely through smaller dimensions, reduced floor width and simplified geometries. While teams will inevitably claw back some of that performance, starting from a lower baseline fundamentally softens the aerodynamic footprint of the leading car.

Not all aerodynamic elements respond equally in disturbed conditions. Devices operating near flow separation (high AoA elements or vortex-dependent geometries) degrade sharply when presented with unsteady flow. The 2026 car concept deliberately suppresses these. Complex over-body appendages have been removed, front wing geometries have been simplified (gone are the days of ultra-complex front wings) and greater reliance is placed on the underbody for load generation.

The consistency of balance under load is not incidental. It is a direct consequence of design priorities embedded into the 2026 rulebook. How the new rules achieve this is by mitigating wake sensitivity

The underfloor, thanks to its fundamentally more stable pressure-driven mechanism, remains effective even when flow is partially compromised. As a result, a larger proportion of total downforce is preserved in wake conditions.

Aero balance migration under wake influence is often more detrimental than the downforce loss itself. A sudden front wing stall shifts balance rearward, forcing drivers to cope with understeer, tyre wear spikes and confidence drops.

Pressure drop

To counter this, the 2026 car places the aerodynamic centre of pressure closer to the car's centre of gravity by increasing the load share of the floor. Because the floor's centre of pressure is near the car's centre of gravity, floor load losses tend to be aero neutral for balance.

As the front wing is most exposed to the wake, so inevitably loses more performance when coming closer to a leading car, cutting its share of total load directly reduces balance shift when its performance inevitably falls. This was possible, as covered in part one of our 2026 aero study in *RE*V35N10, because of the new underfloor design, with more front-biased centre of pressure.

Our CFD investigations confirm this. Even under 11.3 per cent total load loss, aero balance shifts just 2.6 per cent, keeping the handling window consistent and preserving driver confidence.

Gone are the days of ultra-complex front wing geometries. The 2026 regulations aim to simplify this part of the car further, while a reduction in flap span is set to curtail outwash

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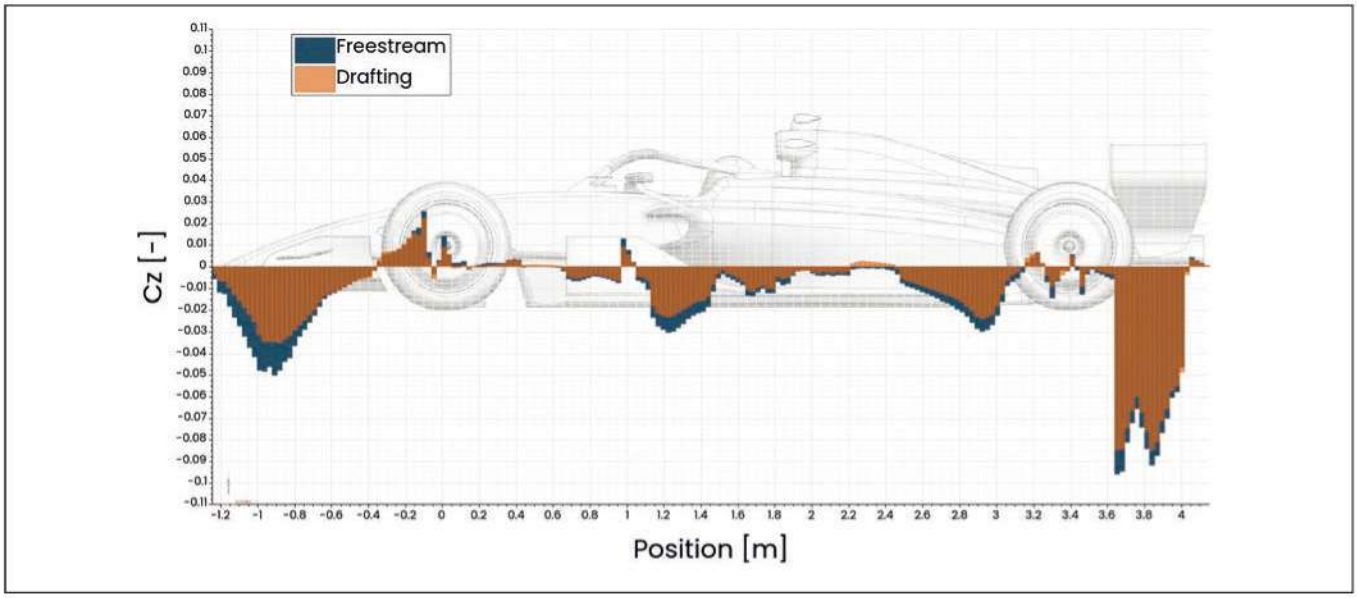

Fig 8: Downforce generation along the car for freestream and drafting cars

With a narrower wake, kept closer to the body, the combined upwash from the rear wing, diffuser and beam wing pushes it upwards… letting cleaner air feed the follower's critical surfaces

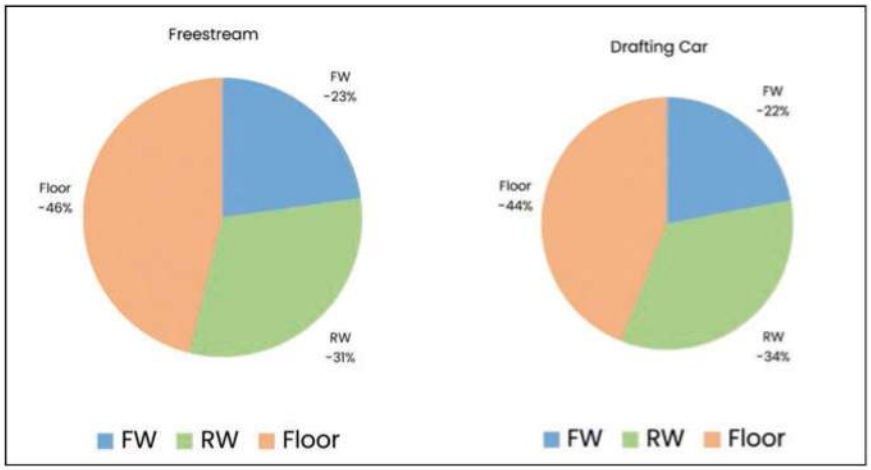

Fig 9: Share of total downforce per element for freestream (left) vs drafting (right) cars

Figure 8 shows how the downforce reduction is quite evenly spread along the length of the car. Total downforce levels drop in every element during drafting, but the distribution is very similar.

Figure 9 shows that the percentage of downforce produced for each part in respect of the total also stays similar. The rear wing gains a three per cent share of total downforce at the expense of two per cent at the underfloor and one per cent at the front wing.

Narrowing the field

The shape of the wake is just as critical as its intensity. The 2026 regulations explicitly aim to narrow and elevate the turbulent flow field through targeted rule changes.

First up is a reduction in the front wing flap span. By limiting this to within the inner faces of the front tyres, the ability to generate outwash, and in turn lateral wake spread, is sharply curtailed. Secondly, the introduction of the 'floor board.' While visually reminiscent of historic bargeboards, its function is very different. On the one hand, the board feeds more air into the underfloor,

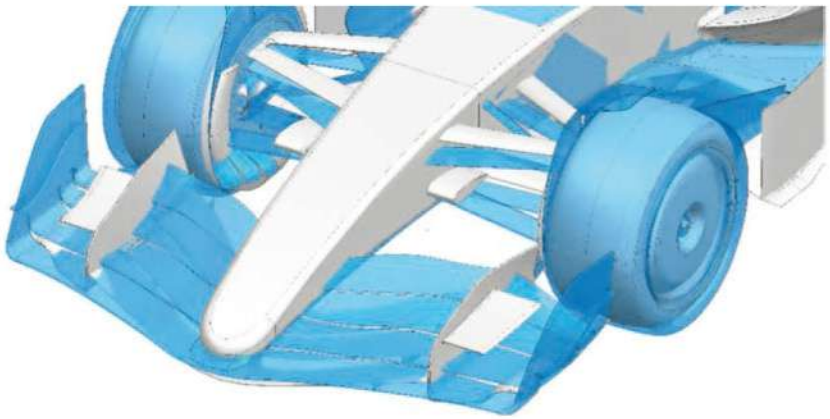

Fig 10: Front wing geometry of 2025 F1 (blue) vs 2026 regulations (white), showing the difference in flap span allowed

creating a suction peak at the front floor and moving the floor centre of pressure forward, closer to the centre of gravity. On the other hand, regulations enforce an inwashing character (opposite to classic bargeboard outwash) helping keep front tyre wake tighter to the body as it travels downstream.

With a narrower wake, kept closer to the body, the combined upwash from the rear wing, diffuser and beam wing pushes it upwards, forming the familiar 'mushroom' structure. This lifts low-energy turbulence above the following car, letting cleaner air feed the follower's critical surfaces. Some upwash will still reach the trailing car but, at one car length, the follower can operate largely in cleaner flow.

The visualisation shown in **figure 13** illustrates the wake topology at one car length separation. By the time the trailing car

Fig 11: Total pressure coefficient (CpT) at Z plane, showing how the new 'floor boards' keep front wheel wake close to the body

Fig 12: Total pressure coefficient (CpT) at Y = 0m, showing the upwash produced by the leading car

Fig 13: Total pressure coefficient (CpT) representing the wake reaching the drafting car

enters the wake region, the bulk of the turbulent structure has already been deflected upwards, largely by the combined upwash generated by the diffuser, beam wing and rear wing.

While some residual turbulence remains in the lower leeward region, particularly near the floor level, the overall wake footprint is narrower and elevated, compared to previous generations. As a result, the following car retains the majority of its aerodynamic potential. Despite a measured SCz reduction of 11.3 per cent, the aerodynamic balance remains largely intact, enabling consistent handling characteristics through corner entry.

Pivotal shifts

The 2022 aerodynamic regulations marked a pivotal shift in Formula 1's approach to wake management. By redesigning the car architecture around ground effect principles, the FIA succeeded in reducing downforce loss at one car length from approximately 47 per cent (2021 spec) to an estimated 18 per cent.

The 2026 rule set appears well positioned to support closer racing and more dynamic on-track battles

However, continued aerodynamic development by teams gradually eroded this advantage until, by 2025, the effective wake penalty had likely increased once again.

The 2026 regulatory package therefore represents a second, more aggressive reset. A combination of design principles underpins the overall concept: a reduced front wing span to suppress outwash, an inwashing floor board to narrow the wake's lateral spread and an aerodynamic architecture optimised to promote strong rear upwash. Collectively, these aim to elevate and compress the wake, while minimising the aerodynamic penalty for a car travelling in pursuit.

Our two-car CFD simulations presented here confirm the potential of this approach. At one car length spacing, the follower experiences just an 11.3 per cent loss in total downforce and only a 2.6 per cent rearward shift in aero balance, well within driver-manageable limits.

Combined with a general reduction in overall downforce, more compact car dimensions and a restructured aerodynamic load distribution, the 2026 rule set appears well positioned to support closer racing and more dynamic on-track battles.

As with any regulation cycle, the performance reset will bring uncertainty, variability and opportunity. Whether these gains are sustained over time will depend on how effectively the regulations constrain aerodynamic exploitation. But for now, the FIA's investment in reshaping F1's aerodynamic DNA appears justified. The true test will come when teams begin to unveil their 2026 contenders, and only then when those cars run in full competitive mode, nose to tail, for the first time.

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All along the watchtower

IMSA's technical team has a new toy to play with as it seeks to keep an ever closer eye on its sportscar series competitors

By ANDREW COTTON

The IMSA Sportscar Championship has upgraded its engineering expertise with the use of the Catapult RaceWatch data and analytics program, which allows its technical team to accurately monitor competitors. At the Petit Le Mans in Atlanta, Georgia, the IMSA team kept track of the 53 cars that took the start of the 10-hour race in four different classes and was able to assess each of them throughout the race in real time.

While the cameras, fans, media and commentators focus on the race incidents and battles on track, deep within the IMSA paddock are two trucks filled with engineers who keep a weather eye on the live data coming from the cars, the track and the television feed to ensure nobody is falling foul of the rules.

The modern GTP and GTD cars produce a mountain of data through their ECUs and scrutineering loggers, data that can now be monitored in real time. RaceWatch has been used in racing for many years, both in F1 and by manufacturer teams in sportscars, but this is an example of a series adopting the system, rolling it out year-by-year in a phased way to its race control, technical team and pit crew.

By regulation, the LMDh prototypes that dominate the top GTP class are limited by the amount of energy they can carry per stint, combining fuel allowance and electrical power delivery from the rear-mounted MGU. They are also limited by the amount of torque they can deliver, monitored through driveshaft-mounted sensors, and by minimum tyre pressure requirements that ensure the integrity of the rubber, as well as balance performance. Other parameters are being monitored at the same time, including differential settings, which are governed by the regulations of the series.

The phased introduction of RaceWatch started with the 2023 launch of the GTP class in the IMSA Sportscar Championship, although it had already been used in F1 and other sports

Two trucks filled with engineers keep a weather eye on the live data coming from the cars, the track and the television feed to ensure nobody is falling foul of the rules

Multi-class racing with tight regulations around power, energy and tyre usage means accurate real-time data logging is critical

Meanwhile, in GTD, for production-based GT3 cars, power is monitored by driveshaft torque sensors. Pit stops are also watched closely, including noting the amount of fuel taken at each stop, the number of tyres changed and any rule infringements, such as spinning the wheels while on the jacks.

The only class that don't produce this same level of data is LMP2, an FIA and ACO formula that uses cars first introduced back in 2017. New LMP2 cars are set to arrive in 2028.

Timing data is received from timing loops around the circuit, broken down into micro-sectors that help IMSA's engineers watching the cars to spot any anomalies that might require further investigation, such as a particularly fast, or slow, sector.

Rapid analysis

Collecting this data requires a huge amount of computing power, and turning that information into something that can be quickly and accurately analysed by human eyeballs is where RaceWatch (also sometimes referred to as SBG, after the name of the company that initially developed it), comes into play. It is a complex, time-stamped, data and analytics system that allows engineers to zero in on a car, either through onboard cameras, television cameras that deliver the world feed, or static cameras keeping an eye on the paddock activities.

RaceWatch collates the information and using the bespoke software written by IMSA engineers and technical partner Bosch, the data is turned into user-friendly screens. For example, tyre pressure monitoring is shown as a line graph that runs from red at the start of the stint as the tyre is coming up to pressure, into a yellow section where it is at required pressure, and then orange where pressure is too high.

As long as the tyre pressure rises above the red zone within a prescribed number of laps, the engineers are satisfied. If a tyre goes above the yellow line, they know to keep an eye on that car's performance during the stint to see if there is any effect on lap time. Relevant information is then shared with race control and used post-race in BoP discussions.

IMSA roll out

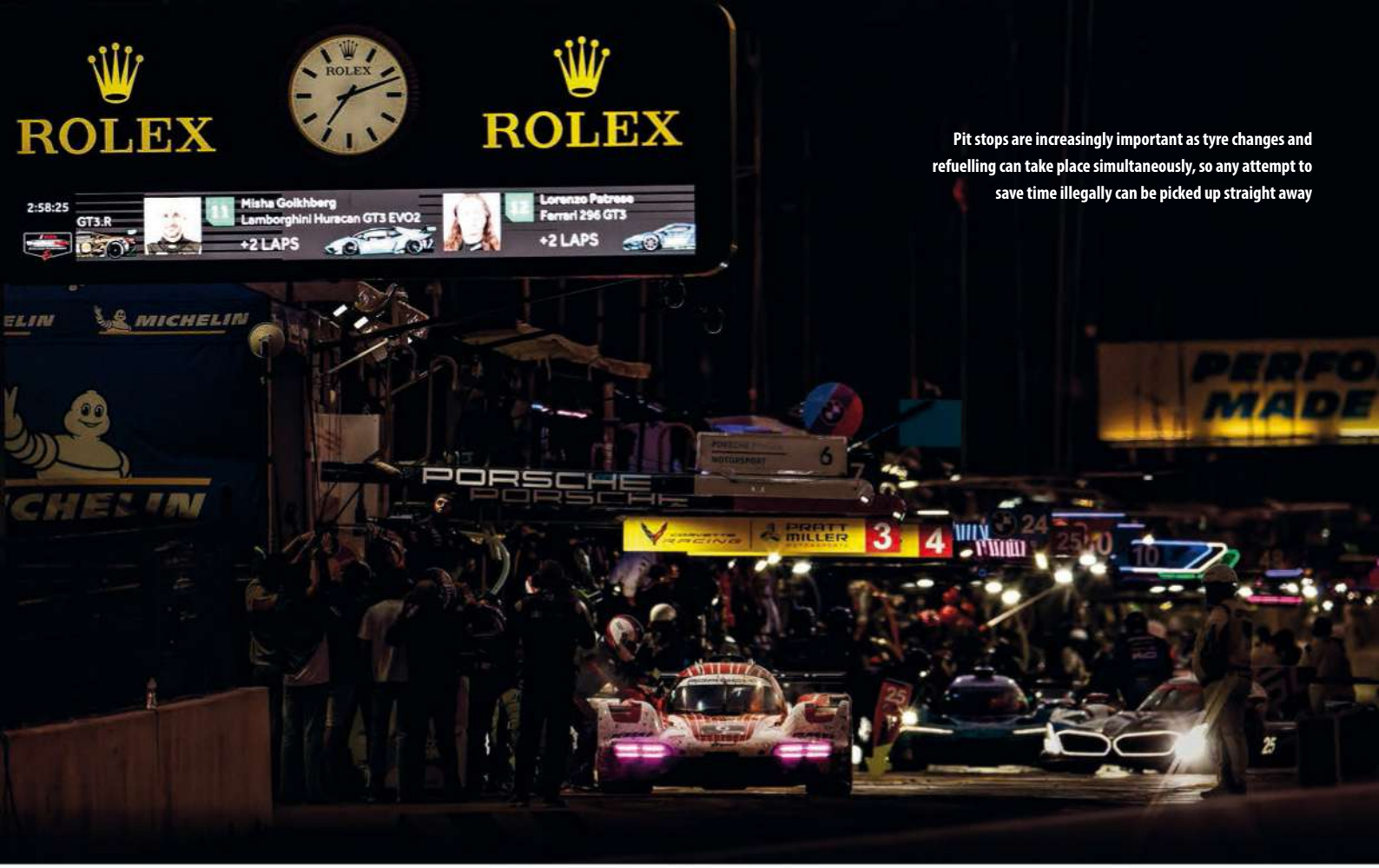
RaceWatch's introduction to IMSA coincided with the launch of the GTP class in 2023, featuring increased data generation through more advanced electronic systems. Race control used it first, and it was then rolled out to the IMSA technical truck for the 2024 season. Next year, pit officials will also have access to it to help monitor pit stops.

Before this huge amount of data was available, IMSA officials used to sit on a 'prat perch' in the middle of pit row. Despite often freezing conditions during the night stint at the 24 Hours of Daytona, the location allowed

Driveshaft-mounted torque sensors provide data to BoP engineers who ensure each car is compliant during a race

Driveshaft sensors can be used to monitor other parameters aside from power output

GTD cars use torque sensors so power output can be monitored in real time, with penalties applied for exceeding limits



Pit stops are increasingly important as tyre changes and refuelling can take place simultaneously, so any attempt to save time illegally can be picked up straight away

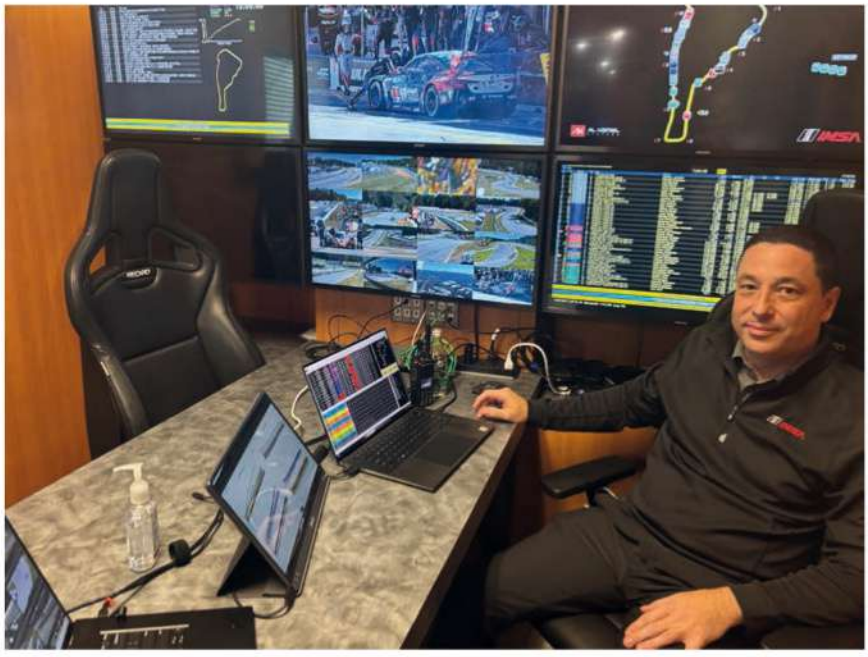
'We have the same capability as the race director and the stewards to review incidents. The timing data, telemetry data and video data is all synchronised through this system'

Matt Kurdock, IMSA managing director, engineering

them to be close to the action. Encouraging them to leave their perch was not easy, but moving to the tech truck not only means they are warmer, but they can better monitor the increasing levels of information, and more easily discuss what they are looking at, and whether to alert race control.

The truck is linked via the fibre optic internet cabling that is fed into the track, and through that system is also linked to the Bosch truck, located next door, which monitors the health and output of the cars' hybrid systems. It is also linked to race control, which has access to the same RaceWatch data as the tech truck. Simon Hodgson, senior vice president, competition at IMSA, sits in race control ready to receive that data and alert the stewards and, where relevant, race director Beaux Barfield.

'We get the live video feeds, and that then allows us to interact with our SBG replay system that not only allows us access to more



Matt Kurdock in IMSA's tech truck, where there's no need for wallpaper thanks to the huge amounts of data available

cameras than you see, but also the in-car feeds and fixed cameras around the paddock,' explains Matt Kurdock, IMSA's managing director, engineering. 'It's the same thing they have in race control, so we have the same capability as the race director and the stewards to review incidents. The timing data, telemetry data and video data is all synchronised through this system.

'They take care of the sporting side of things and we do the technical, so it increases visibility on how the race is playing out. If there is something we need to investigate in terms of a car having an issue, not just from an engineering perspective, but the technical inspection aspect, responding to a car having damage, we can guide them in their next pit stop as to what repairs we need.

'We also work together on the sporting side of things, so we look to see if cars are in compliance as well. People are still on the timing stand, basically having that exposure on pit lane, but they're working with the officials on the hot side of the wall, with a connection to us and to race control so we can respond to incidents at all times.

'That not only helps officiating on pit lane, but also race control. It has made our race operations more seamless, and brought the interaction between race control and us to a higher level.'

Over the other side of the Atlanta track in race control, former driver, David Donohue, has grown particularly adept at managing the television controls. He is supported by three other ex-drivers who contribute their opinions of incidents, and decide whether or not to penalise driver behaviour on track.

Unlike European systems, stewards sit in the same room as the race director, who is assisted by a team monitoring various aspects of the race, including communication with the marshals and the safety team, enabling clear, fast and accurate decision making.

Reliable data

In the tech truck, the main job is to collect reliable data, from which decisions can be made. Timing and scoring, and connection with the pit and race control, is all done via fibre optic cabling. However, collecting information from the cars is slightly more complicated, relying on mobile phone masts located around the circuit. And there is a lot of data coming from each of the cars.

It has led, in the past to certain sections of the race going 'dark', particularly during busy times, such as the race start at the 24 Hours of Daytona. On top of all this, the phone masts also have to cope with the huge amount of data from spectators' mobile phones and can become overwhelmed. To avoid this, the IMSA tech truck has additional back-up systems, so even if there is a dark section of a race, they can replay through it and find any anomalies that need to be addressed.

'The GTP, GTD and GTD Pro classes all use a Bosch telemetry system. That data comes through LTE cellular networks down through the cloud and this is where we do distribution magic, and get it into this truck, into the broadcast and a web page with telemetry that goes to the fans. The telemetry is a critical operation for us in terms of regulating these cars,' explains Kurdock. 'There are fundamental things that we regulate in GTP. The torque sensors are regulated to the prescribed power, how differentials are being used, torque distribution between driveshafts (and, in a four-wheel drive car, between axles) and energy through the energy tank.'

Performance monitor

Bill Pearson sits close to Kurdock in the technical truck. Pearson is IMSA's director, performance, and he monitors the RFID (tyre identification programme used by Michelin), violations in GTP, energy usage, fuel usage, expected length of stints, high voltage monitoring and the actual performance of the cars.

Bill Pearson's impressive race day set-up involves power delivery monitoring, live timing and performance graphics

Matt Kurdock has the ability to delve deep into the live data during a race to see what each car is doing

'There is the data that comes through the mobile networks, and there are multiple levels of redundancy to our network connection,' he says. 'We are gathering it through the transponders, and the way they are configured means we are getting the critical information that is being logged on the scrutineering loggers in the cars so the car knows it has done something wrong. That is then flagged to us as well, so we can see these things through more than one method. To be honest, it's pretty reliable. Tech ops do well to make sure we have the network we need. If something goes down, when it comes back up, we will know. If a car is turned off, or whatever, we will know.'

The team, which has its own barometer to help analyse the accuracy of engine performance, is also able to connect with the scrutineering logger with two-way comms. If there is a sensor failure or discrepancy, for example during refuelling, the team can monitor how long the car was stationary, how long the fuel probe was connected and how much fuel was taken onboard, and correct the logger to carry the right information. That prevents the car needing to make an extra stop to recalibrate or rectify a problem.

Stewards sit in the same room as the race director, who is assisted by a team monitoring various aspects of the race… enabling clear, fast and accurate decision making

Reliability is clearly an issue for the data, and IMSA has been tricked in the past. At Daytona in 2023, false tyre pressure data was

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Rising average graphs demonstrate who is competitive and who is not. It's an overview, but the detail can reveal why

being sent to IMSA by the race-winning team, which was subsequently fined and handed a significant points deduction.

'Through every learning experience like that, we as a series have to adapt and address potential vulnerabilities in our monitoring and regulations. We are constantly trying to improve the data integrity in the pressure sensors, torque sensors, anything that we use to regulate the competition,' says Kurdock. 'It is a migration of us learning what capabilities are on the horizon and learning where some may be tempted to exploit, and trying to adapt our hardware in the cars.

'There are also some software and encryption methodologies to make sure that what we are using to regulate the competition is of high integrity. Globally, in alignment with other sanctioning bodies, there was a development of encrypted technologies. Through this alignment, we have more stringent hardware requirements and more sringent communication standards.'

Primary focus

Once the data is proven to be reliable, it can then be used to predict how the race is playing out. 'Our friends from HH Timing and data management are in the trailer running the systems, and live analysis, and we each have access to how each race is playing out, such as standout sector times. Why, for example, is someone able to go further on energy than another car?' continues Kurdock. 'We can go into these tools that paint a picture of the race.

'Our primary focus is to make sure the system is working and that all the cars are in compliance. After that, we know we have that other job to do after the race. We know it is better to stay on top of how the race is playing out, and the performance metrics, than to wait until the end of the race and then start that job. When we come out of [the truck], we are all going to have a different view on things, so we sit down as a collective and say, okay, did you see the second stint on this car? They double stinted, so that is the performance separation.'

Not only are race officials better informed in real time, but validation of the performance balancing process can now be backed up with hard data

This, then, feeds into the BoP, a process that takes place after the race, and it is all data driven, with more information than ever before. Race data is collated, including any anomalies such as car damage or strategy, and calculated. A table is then presented to the teams, along with an explanation, as part of a working group.

The change in process has dampened complaints regarding the BoP of late, although they remain close to the surface. Using RaceWatch means not only are race officials better informed in real time, but validation of the performance balancing process can now be backed up with hard data, meaning there are fewer places for performance to hide.

This data-driven approach has helped IMSA to control the grid during races. Not only on track, but also in post-race tech, IMSA engineers are able to speed up their decision-making processes. Once the new LMP2 cars arrive, the tech truck should have real-time data for all its competitors.

Beyond motorsport

First launched in 1999, the RaceWatch system takes multiple sources of data and applies it in a manageable format that can be used to improve or regulate competition.

It was developed initially for general professional sport, including athletics and American football, to help with fitness and strategy for the athletes. It was first picked up in the US by basketball team, the New York Knicks, in 2010, and is now used in soccer – which has increased its investment in the system – plus baseball, rugby union, tennis, cricket and e-sports. In motorsport, it was first rolled out in Formula 1 and NASCAR, with IndyCar and IMSA jumping on board in 2023.

In rugby, for example, the system is used to analyse scrum duration, contact involvement, player load, collisions, maximum speed, acceleration and deceleration of players, as well as a kick counter. For American football, it can analyse lineman contacts, quarterback throws and impacts, as well as contact load, throw load and impact load.

RaceWatch is a cloud-based data collection and analytical computer program that, in motor racing, can be used to synchronise data, including timing feeds, GPS, telemetry, race control messages, weather reports, team radios and live video. In all applications, teams can add, edit and organise video clips, alongside analysing performance data.

It is used by IMSA, and by teams that race in the series, to analyse a race in real time, but the information is also stored for a complete race review once the dust has settled. Race data from each event is collected by IMSA and stored on three hard drives that are taken from track to track, one active and two back up. With all data shared with race control as well, the system allows for all in-race incidents to be analysed rapidly and accurately.

'RaceWatch has been an essential part of racing operations at Williams for over 10 years,' says James Vowles, team principal at Williams Racing in F1. 'The combination of powerful data analysis, intelligent prediction and clear visuals, all synchronised with video and audio, makes it an invaluable tool for engineers and stakeholders across the team.

'When every second matters, it's key to have a tool that not just provides the important information at every stage, but also removes overhead, stress and guesswork out of managing qualifying and the race.'

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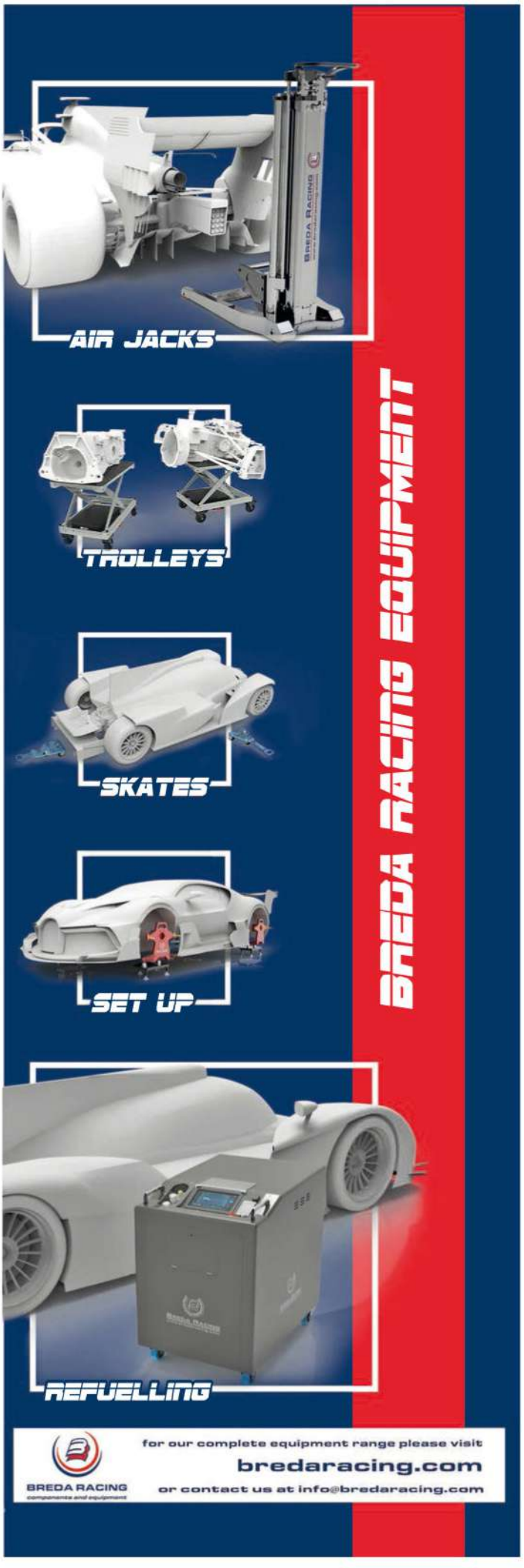


National treasure

After a rocky period, the DTM is finding stability again under GT3 rules. How was that achieved, and what seeds are being planted for the future?

By DANIEL LLOYD

When the DTM adopted GT3 cars in 2021, it marked a watershed moment for Germany's top domestic series. During the late 1980s and early '90s, the Deutsche Tourenwagen Meisterschaft featured touring cars as the name suggests, and drew in major German brands including BMW, Opel, Audi and Mercedes, as well as the Italian manufacturer Alfa Romeo.

After a demise and rebirth at the turn of the millennium, the DTM morphed into something of a hybrid between touring cars and sportscars, using unique silhouette racers. The OEMs kept racing and their rivalries only intensified.

The series then worked with Super GT in Japan to develop a common chassis and engine formula based around 2.0-litre, four-cylinder turbocharged unit, which further cultivated this particular silhouette branch of the motorsport family tree. However, following the departures of Mercedes and Audi after the 2018 and 2020 seasons, Class 1 collapsed in Europe, leaving the DTM at a crossroads. With its future in the balance, the organisation in charge at the time, the ITR, took the decision to pursue a sportscar-based direction, and the DTM became one of many series to adopt the globally successful GT3 platform.

Five seasons in

Five seasons have now passed since that decision. The ITR steered the ship for the first two years of the new-look DTM, until 2023,

The ADAC took over running the DTM in 2023. It has now been five years since the series adopted GT3 cars

ADAC

DTM is still going, and going strong, judging by the 102,000 people who flocked to the 2025 season finale at Hockenheim

when it was replaced by Germany's largest automobile club, the ADAC.

When GT3 was adopted, question were asked whether or not the series had lost its way. It is the called the German Touring Car championship afterall. Many suggested it would be a shell of its former self if it relied on cars that raced elsewhere, including in Germany at the Nürburgring 24 Hours and in ADAC GT Masters. Some questioned whether DTM would be lost completely in the noise of an already oversaturated market.

Fast forward to today, though, and the answer to those questions is no. The DTM is still going, and going strong, judging by the 102,000 people who flocked to the 2025 season finale at Hockenheim. So, how has the ship been steadied after the DTM departed its silhouette rules and joined the GT3 world?

Distinct features

Although the DTM uses the same car as other GT3 series, it has distinct sporting features. DTM races are 55-minute, single driver affairs.

Each round consists of two races. The first enforces a mandatory four-corner tyre change pit stop, for which there is no minimum standstill time, while the second features two pit stops. This is different to a similar-looking series like the GT World Challenge Europe Sprint Cup, which runs 60-minute races but with two drivers sharing a car and a minimum pit lane delta time to hit.

The Sprint Cup also has different classes, so the grid contains a mixture of professional and non-professional drivers, whereas the DTM's single driver, one winner approach gives it a Formula 1-like edge. Plus, the DTM doesn't allow tyre warmers, while GTWC Europe does. Both series also use the same Pirelli tyre, although that will change next year (see box out on p43).

The DTM's sporting distinctions help create subtle deviations in how teams go about their work and set up their cars, when compared to other GT3 series.

'In DTM, you don't have to make any compromises because you just set the car up for one driver,' says Thomas Gleibs, race engineer at Winward Racing. 'For example, we have Maro Engel and Lucas Auer [sharing a car] in GTWC Europe Sprint. They have very different driving styles, so you always compromise the set-up a bit. Auer likes more oversteer, Maro likes the car more neutral and not moving so much on entry. In DTM, however, you know your driver's style and the set-up they need.'

Close competition

The DTM has nine manufacturers currently competing. In the spirit of GT3 as a customer racing category, the OEMs don't run the cars themselves but provide support (often including cars and drivers) to independent teams. To keep the manufacturers in close competition, the series deploys a BoP system, curated by the SRO Motorsports Group, which also runs GTWC Europe.

'The approach is to have a very high level of racing and competition throughout the paddock, including BoP,' says Michael Rebhan, sporting director at the ADAC. 'The target we have for the BoP is a gap through all manufacturers from 0.1 to 0.2 seconds. Other major [GT3] series are going more to 0.3-0.5 seconds.'

Rebhan adds that the ADAC's priority since it took over the DTM in 2023 has been to maintain a high level of car performance, combined with even competition and the known GT3 technical regulations. It knows the formula well, having run the ADAC GT Masters since 2007.

Very similar, but not identical (for example, GTWC Europe imposes a front camber limit of four degrees, whereas no such maximum exists in the DTM), this affords DTM team engineers a bit more set-up freedom, which helps when searching for minute gains with a single driver who isn't sharing the wheel.

'From a technical spec, it is the same car as [used in] GTWC Europe,' adds Gleibs. 'It is more about the teams looking into the [smallest] details. Within the regulations, you are trying to have the best parts. Within a certain limit, you can work on the wheel bearings or brake calipers to have less friction. You can go a bit more to the limit because you're doing one-hour sprint races.'

Audi Sport

From its 2000 rebirth, the DTM started to forge its own technical path, away from traditional touring car and sportscar rule sets and with bodywork loosely resembling road car products. This branch of the family tree culminated with Class 1, seen here

ADAC

Although the DTM uses the same type of car found in many other series, and a very tight BoP, its distinct sporting format creates subtle deviations in how the teams that compete in the series prepare their cars and search for the marginal performance gains

Closing loopholes

The ADAC's technical team has tagged onto this trend among the teams. On occasion, it has stamped its authority in its quest for close competition and cost mitigation. Ahead of the 2025 season, the ADAC and the SRO introduced an addendum to the FIA GT3 homologation form, clarifying some grey areas that teams had been exploiting. One topic was the use of different wheel bearing materials and sizes, as well as greases, to save weight and have better friction properties. Now, the properties are clearly defined. Another topic involved the braking system.

'You have a small spring in the brake caliper that pushes the piston onto the brake pad and that creates more friction when the car is running freely on the straight,' explains Robert Maas, ADAC technical coordinator.

'The target we have for the BoP is a gap through all manufacturers from 0.1 to 0.2 seconds'

Michael Rebhan, sporting director at the ADAC

BMW

Pit stops are by regulation conducted as fast as the teams can handle, with no minimum standstill time. Drivers don't have the benefit of tyre warmers, which are permitted in GT World Cup Challenge Europe

ADAC

In 2025, the SRO and ADAC developed an addendum to the FIA GT3 homologation form, clarifying some areas in which teams had been pushing, in the series organisers' opinion, a little too far. The manufacturers have approved this move, the teams less so

'Some teams were taking those out and putting softer ones in. The idea is that you need to pump the pedal a couple of times before the braking point, but it gives you a top speed advantage. All of these small details cause differences in performance.'

The performance differences he mentions are those between teams using the same manufacturer's GT3 car, and not the BoP, which handles the performance variations between manufacturers.

'You might have two teams from the same manufacturer, but the gap between them might be 0.5s per lap,' suggests Maas. 'You could then really see that everyone is not using the car as delivered, but as they think works best. It gets quite expensive, for a GT3 level, where you buy a new car, but you have to invest hundreds of thousands of euros to make the most out of it.'

Naturally, the teams feel as though some of their freedoms have been removed with the arrival of homologation amendments.

'It's quite big,' reckons Gleibs. 'Everyone is pushing on every part. It went quite far, so that on brake calipers, teams started removing knock-back springs and modifying caliper seals. They [the ADAC] tried to make more regulations and the costs more equal. Just for us, it hurts a bit, because this was worth 10 years of experience.'

Different rhetoric

When the DTM adopted GT3 cars in 2021, one of the ITR's ideas was to stand out from other GT3 series by being faster. One suggestion was to have some kind of 'GT3-plus' kit, which the manufacturers were against. There was also a proposal to maintain standing starts, a feature of the Class 1 days,

'Whenever we need to do something different, it's for a really good reason. The sport needs to be at the highest level, but stable. Our most liked word is stability'

Michael Rebhan

but this was a non-starter because it would have forced teams to install specialist clutches at high expense. A key to the GT3-based DTM's survival has been an aversion to such drastic departures from what other series are doing; the initial rhetoric of wanting to stand out from the GT3 crowd has faded away.

'We are not about being the fastest, but about being cost effective,' states Rebhan. 'For us, this is high-level performance and sport, but it's also a show; we have good TV numbers. The sport has to be good and understandable for the fan. If we achieve this, it doesn't matter if another GT3 series comes along and is 0.2 seconds faster than us. Whenever we need to do something different, it's for a really good reason. The sport needs to be at the highest level, but stable. Our most liked word is stability.'

This will be music to the ears of GT3 car manufacturer bosses, many of whom have expressed concern at the potential for increased technical divergence between GT3 series. These differences were explored in detail in *RE* V35N7. Chief among them is the mandatory use of torque sensors for BoP reasons in the FIA World Endurance Championship and IMSA Sportscar Championship, but not in GTWC Europe. The DTM hasn't adopted them either. Rebhan estimates that such technology would add approximately €150,000 (approx. $174,000) to each annual two-car team budget, which is understood to be around €1.5-1.8m (approx. $1.74-2.09m). Torque sensors therefore won't be properly considered until the former number shrinks.

One reason for the high cost is that the only company currently making torque sensors for GT racing, MagCanica, is based in California. The ADAC also questions how such technology would work in a sprint series.

'In endurance racing, you can work around during the race if something is not working 100 per cent,' notes Rebhan. 'Here, you need to be straight: if it's okay, you race; if it's not okay, you're out. At the moment, it's not in a configuration where the surroundings are in a way that we can use it.'

Maas adds: 'What is happening in IMSA and WEC is that it's becoming a software battle. Every centimetre on the track, the car knows

XT1 is about pitting different powertrains against each other, in a so-called 'Battle of Technologies'

exactly where it is. It can adjust engine performance based on the kerbs; it's getting a bit crazy. To manage that, you need more manpower. Software engineering is like a black hole where you can just throw money.'

The ADAC's approach to running the DTM isn't flashy, it's sensible and it is working. It has persuaded those in the paddock, many with great experience in other GT series, that GT3 is the best platform to take the series forward. It has gained the manufacturers' broad support and knows that major changes are likely to be met with scepticism.

A cynic might view it as the DTM sacrificing its individuality to ensure a healthy, diverse grid, for if that individuality (which was a source of prior popularity) was sought after again, costs would spiral and grids could suffer. However, BMW M Motorsport director, Andreas Roos, doesn't see it that way; he instead views the DTM's approach as a win-win for both parties.

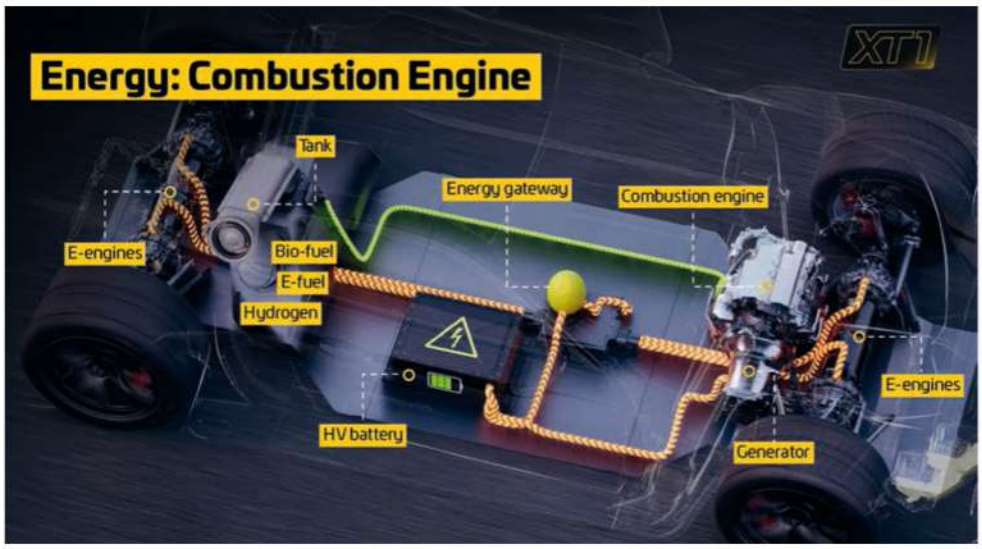
'We are nearly in every championship worldwide with our GT3 car,' says Roos. 'If we made special cars, we would have to pick maybe two championships, because we could not afford to build six different types of car. I think we all win at the moment because of this stability and common rule set. The promoter wants a lot of cars and good racing; manufacturers want to race in as many championships as we can, with very competitive fields. On top, I think it would not be the right time at the moment, when you look at the automotive industry, to go away from this focus to have common cars. The budgets are not there.'

Introducing XT1

It's almost unthinkable to imagine motorsport without GT3, the category having become so ubiquitous around the world. But its success doesn't mean there haven't been considerations about what might come next. The ADAC has decided to take the initiative by creating its vision for a future technical regulation concept, which it calls XT1.

Revealed at the 2025 DTM finale, XT1 is about pitting different powertrains against each other, in a so-called 'Battle of Technologies'. It is designed to appeal to an automotive industry that currently envisages a panoply of greener propulsion methods.

The announcement of XT1, made in English, also seemed to demonstrate how the ADAC wants to increase its standing on the international stage. Delegates from other



ADAC

Impression of what an XT1 chassis with a sustainably-fuelled internal combustion engine might look like under the skin…

ADAC

ADAC motorsport director, Thomas Voss, says GT3 is the secure option for the DTM for years to come, but XT1 represents the need to have a long-term vision

organisations, such as the FIA and IMSA, were invited to a presentation held just before the public announcement. GTA, the organisation which runs Super GT and still uses the Class 1 rules that the DTM abandoned, was also invited, its chairman, Masaaki Bandoh, flying over from Japan for the occasion.

'Motorsport *has* to be relevant for the fans and the car manufacturers,' says Thomas Voss, motorsport director at the ADAC. 'This regulation [puts] everything that is on the market together in one race. At the moment, people are hesitating [about] what their next car should be. Should it be hybrid, battery electric, combustion? It is one goal for motorsport to clear this up and show people that all those technologies can work under high pressure. Somebody has to make the first step.'

The base of the XT1 regulation concept is a chassis with four electric motors, one on each wheel. It has a target weight of 1600kg and a target output of 1000bhp, with comparable lap times to GT3, based on it producing almost double the power but weighing around 300kg more. The e-motors will receive their power from a variety of powertrain sources, like a hydrogen fuel cell, hydrogen combustion engine, ICE or battery. The four-motor arrangement was chosen because the ADAC saw that lots of OEMs were advocating some form of electrification. An inspiration, according to Voss, was the BMW 5-series, which can be adapted to fit ICE and battery-electric powertrains.

In XT1, the e-motors will be mandatory, so a car may not use a sustainably-fuelled ICE on its own. They will be a spec part among all manufacturers, while the inverters and VCU are also expected to be common.

Manufacturers will be responsible for building their own chassis and will be allowed to make cars that reflect a touring car or GT style. This doesn't mean hatchbacks and Porsche 911s will race each other, as the ADAC's promotional video for XT1 suggested. Rather, the intention is for the XT1 platform to accommodate whichever body style the industry ultimately prefers.

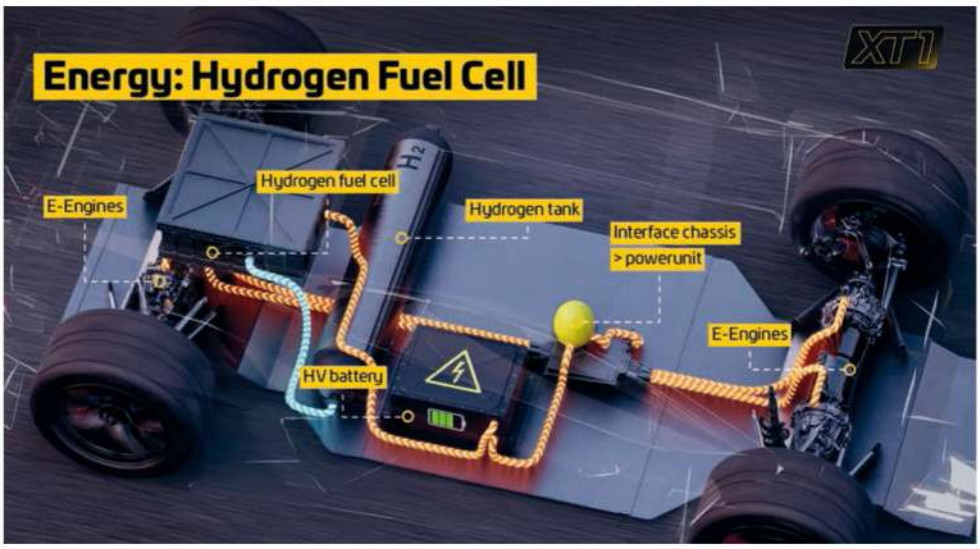
Technology balancing

The concept relies on a technology-balancing platform that ensures any powertrain type can win. The ADAC is using the 'Battle of Technologies' moniker, which the FIA World Rallycross Championship touted in 2024 and 2025 when it re-admitted ICE vehicles to race alongside EVs. However, in XT1, the situation is different because there will be no ICE-only vehicles; everybody will race with the same four electric motors.

'The problem with a combustion engine, even with torque sensors in, is that you have a fixed torque curve,' says Maas. 'With a turbo engine, you might be able to adjust it slightly, but with an electric motor, you can do any kind of curve you want, within the technical limits of the motor. We have a lot more freedom to adjust the cars. So, even if you have different concepts with different acceleration profiles, you can adjust the torque curve and get them closer together.'

The VCU will be at the heart of this control strategy, Maas highlighting that different levels of access can be set up, to control how

ADAC



…and the same for a hydrogen fuel cell. The four electric motors found in each car will be tuneable to balance the different powertrains

ADAC

As part of its push for stability, the ADAC brought GTWC Europe supplier, Pirelli, on board for the DTM in 2023. A bespoke tyre will be launched next year as the two parties renew their contract, mainly to even the field

much software development the teams need to do. One thing the ADAC wants is for the cars to be difficult to drive, with low downforce and no electronic driving aids like traction control and ABS, which exist in GT3.

Complete freedom

'We don't want a car on rails,' confirms Maas. 'We can adjust the drag numbers and [correspondingly] put more power through the VCU. That's the best tool to start balancing. You can make the car heavier, give it more downforce, to reach a certain cornering speed, and then adjust it again on the e-motors, giving it higher torque. That's why the electric motor is the best playground to adjust the cars, because it gives complete freedom, and it's done by software.'

XT1 was drafted without manufacturer input but, following its unveiling, a technical working group will be set up between the ADAC and interested parties to hone details.

'The basic concept is interesting,' says Christoph Sagemüller, head of Mercedes-AMG Motorsport, which intends to join the working group. 'One question is, of course, how to finance it. Also, the basic idea of which parts should be the same for all manufacturers. For us, it's better to showcase the technology we develop, like electric engines. We want to bring this know-how to racing, so I think this will be discussed about what the manufacturers can do. It's an interesting idea and step. We will see how it develops and how the other manufacturers are positioned.'

The ADAC hopes to conduct the first track tests for XT1 car in 2027 or 2028, to be ready for a 2030 race debut. That's an ambitious timeline and is far from concrete. The bigger question is, will XT1's introduction signal the end of GT3 in the DTM?

The future

'We are also thinking about the future of DTM,' offers Voss. 'I am completely convinced that we will see GT3 in DTM over the next eight to 10 years. But developments in GT3 are getting more expensive each year. As customer sport, you have to be careful. Especially in Germany, if you don't have sustainable technology in your car – it's the reason we use carbon-neutral fuel – it is very hard to find sponsors.'

Adopting GT3 has enabled the DTM to rebuild following a rocky transition after Class 1's demise. It has become an increasingly domestic series, with six of its eight rounds taking place in Germany, but there are considerations to venture further afield again, perhaps even returning to the UK.

However, despite its touring car roots, consolidation has worked, both in securing domestic fan interest and maintaining close racing by not straying far from the established GT3 technical base. This, the ADAC hopes, will ensure the DTM remains the backbone of German motorsport for years to come.

Tyre divergence

The ADAC has been trying to instil technical stability in the DTM. However, its announcement in October that Pirelli will develop a bespoke tyre for the 2026 season appears to be at odds with that. The Italian company replaced Michelin as the series' official supplier in 2023 and, since then, has deployed its standard customer racing tyre found in other sportscar series around the world, most notably in GT World Challenge Europe. However, next year, the DTM will deviate from the global Pirelli P Zero DHG with a new specification developed at the Italian company's German technical centre. Although ADAC motorsport director, Thomas Voss, hinted that the new tyre could produce quicker lap times, that is not the main reason for its introduction. Rather, it is primarily about equalising the teams, some of which use the P Zero DHG in other championships more than others.

'The idea is to have a limited number of sets for each driver, for testing and racing,' says Matteo Braga, circuit activity manager at Pirelli. 'It will probably be the same allocation for the races as it is today, and a dedicated allocation for testing. The number of tests will be limited, like it is today. One of the targets was to better equalise the efforts of the teams. We have teams racing in other series and getting different experiences about the product. It's a small advantage that you put in your know-how. [With a specific DTM tyre] everyone will have the same amount of track time to learn about the performance.'

Technical details of the bespoke DTM tyre are under wraps for now, with Braga declining to say how the compound will compare to the current DHG. Shortly after the tyre's announcement, one manufacturer expressed concern that a lower volume product could increase costs for teams, and that it might create complications when setting the BoP due to a lack of real-world data compared with the global DHG. According to Braga, the 2026 tyre will be 'not much more' expensive than today.

'Putting everything together, we will have different performance from what we have today on the standard DHG,' he adds. 'But the targets, in terms of mileage and how you handle the product, should be quite close to what we have now, because we don't want to move too far that we disorientate the teams. They have 15 years of know-how using our products. We don't want to design something that is completely out of range.'

Sheer Kahne

How a family race team beat the established players to corner the World of Outlaws shock market

By BOZI TATAREVIC

Factory Kahne Racing Shocks started as a small project for brothers, Willie and Kole Kahne, as they worked on the sprint cars of their cousin, Kasey Kahne, an 18-time NASCAR Cup Series race winner. As word of their innovations started to spread around the dirt racing paddocks, business increased, and now their shocks (otherwise known as dampers), with patented valving, dominate the World of Outlaws class, and feature in many other dirt racing tours worldwide. Now, if you wish to be competitive in a race series like World of Outlaws, you likely need to be running Kahne parts on your car.

Willie never expected to launch a shock company but, being a crew chief, he was always looking for an edge to make their sprint cars faster. So, he started disassembling the Penske Racing Shocks products the team was using in 2008 / '09 and replacing the internals with ones he had designed with the help of his brother and some engineer friends. They quickly saw success.

In 2009, the brothers made a request to become a Penske Racing Shocks dealer, in order to sell the customised units to others, but Penske saw the Charlotte area as too saturated and denied the request. The only choice, then, was for Willie and Kole to launch their own shock production, so they went off to find manufacturing and engineering partners to design one from scratch, and Factory Kahne Racing Shocks was born.

Racing focus

Willie Kahne doesn't come from a traditional engineering background, though he has a very good mechanical mind. He spent his teenage years on the west coast of the US working on a dairy farm to save up money to buy a motocross bike. He admits his focus wasn't on school; he wanted to race, though quickly realised he wouldn't have the funding to chase a professional career.

The company's made-to-order EVO shock range offers a balance of traction and stability with tuneability, various stroke options and a 5-7 day processing time

The location of the shop in the Charlotte area meant Willie had access to a variety of NASCAR suppliers, which led him to testing on pull-down rigs and using K&C testing tools to help improve his company's shocks

Development and simulation work in the lab is all well and good, but there's no substitute for hands-on experience

Instead, he decided to support his cousin, Kasey, as his mechanic through a variety of west coast dirt racing programmes on two wheels and four. When Kasey was sent off to a race programme on the opposite coast, Willie carried on his mechanic work with local dirt racing teams to learn the trade before eventually joining Kasey out east. The reunion was short lived, though, as Kasey was being pushed into pavement racing by Ford, which reduced his dirt schedule. Willie decided to chase a dream and went to work for Karl Kinser, whom he credits for teaching him a lot of the approach he uses today.

Willie would return to work for Kasey after Kasey Kahne Racing (KKR) was established in 2005 and that's where the seeds for Factory Kahne were planted. As a crew chief for sprint car racer Joey Saldana, Willie continued modifying the Penske shocks they were using at the time, which helped Saldana secure multiple wins, including the prestigious Kings Royal at Eldora Speedway.

The location of the shop in the Charlotte area meant Willie had access to a variety of NASCAR suppliers, which led him to testing on pull-down rigs and using kinematics and compliance (K&C) testing tools to help improve his company's shocks, as well as other chassis and suspension components.

KKR went on to become one of the earliest dirt racing teams to use data acquisition to analyse and model the performance of their cars. The team initially worked with Pi Research to build a custom solution, which is now in possession of Factory Kahne, but later moved to a data acquisition package from Aim Technologies.

Willie's brother, Kole, helped interpret some of that data, and assisted with designs. Willie says he has always preferred to be a pencil and paper engineer, so many of his

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They studied every shock available on the market in detail, noticing each manufacturer had something that made it stand out, but no one was combining all the ideas into one unit

Simplicity is a key design feature of Factory Kahne shocks, along with the ability to fine tune for specific dirt racing environments

shock components would be hand drawn and then digitised by Kole in CAD.

Kole wasn't the only one that offered a helping hand in progressing the shocks; the brothers also became friendly with engineers at Evernham Motorsports, the team for which Kasey was driving in NASCAR. One of them Willie credits with being a huge resource in their early days was ex-Penske Racing Shocks employee, Nick Hughes, who helped him analyse and understand some of the concepts of shock design before he moved to Australia to join PWR and DJR Team Penske and then, more recently, General Motors to build simulator suspension models.

Season won

The brothers ended up striking a deal with C&R Racing, the engineering and machining portion of what was C&R Radiators at the time. That partnership allowed them to build their first complete shock in 2009. En route to the World of Outlaws World Finals at Charlotte, Kahne ended up winning 20 A-Feature races that season.

Willie freely admits their early shock modifications and builds weren't hugely revolutionary, but they focused on the details and found that if they customised components specifically for the sprint car environment, they could have a better set-up than their competitors, most of whom were using shocks adapted by their manufacturers from other racing disciplines.

They studied every shock available on the market in detail, noticing each manufacturer had something that made it stand out, but no one was combining all the ideas into one unit.

It didn't take long for word to spread around the paddock that the shocks Kasey Kahne Racing was using were different to everyone else's. For starters, most sprint car competitors were running twin-tube, oil-based shocks, while Factory Kahne units were gas filled. That went against conventional wisdom at the time as most World of Outlaws competitors felt gas wasn't forgiving enough for their racing conditions.

According to Willie, the twin-tube shocks were dominant at that time because the lack of rod pressure in that style of shock allowed competitors to have a better feel for the behaviour of their cars. That shock design also allows for a larger operating window so, as track conditions changed, teams wouldn't alter their settings a huge amount from session to session.

Factory Kahne, however, decided to focus solely on gas shocks to start because, while they are less forgiving, Willie saw an advantage in building more specialised shocks that were better suited for a specific track, or track condition, rather than one with a wider operating window that might compromise performance.

Factory Kahne did eventually design a twin-tube shock of its own when it saw there was a market for that type of product, but used some of the design ideas it learned from its gas shock in its construction.

In early 2010, Factory Kahne officially started selling shocks to other teams, though initially only to a few select smaller outfits. The big break came when two-time World of Outlaws champion, Jason Meyers, convinced one of the teams to let him borrow a set of their shocks for a test at Knoxville Raceway. Meyers was 200 points behind in the championship standings at the time, and that test proved to be pivotal to his season as he tested every type of shock available, eventually concluding the Factory Kahne units stood out from the rest.

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5M1581H-.25	6M1581H-.25
5M1581H-.50	6M1581H-.50
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Some of the things [Willie Kahne] found that looked good on a dyno chart did not necessarily translate to the real world because of the very specialised conditions of dirt racing

Meyers immediately called Kahne to spec and purchase a set of his shocks, going on to secure the first of his back-to-back World of Outlaws championships running them.

It was a bittersweet moment for the brothers as a KKR driver was also battling for the top spot, and the knowledge that something they had built had allowed a competitor to pass them in the championship standings was a tough pill to swallow. However, it also marked the launching-off point of Factory Kahne Racing Shocks into the World of Outlaws sphere.

Design philosophy

Factory Kahne's design philosophy has always been a testing-first environment, and Willie says many of the company's early designs were based on notes he had collected in over 15 years as a crew chief. That experience taught him that some of the things he found that looked good on a dyno chart did not necessarily translate to the real world because of the very specialised conditions of dirt racing. While dirt racing may seem like a brash sport, precision in manufacturing was where they found some of their earliest advantages because many of the competing products had tolerances, or sealing systems, that weren't aimed specifically at the dirt environment.

Time was also a huge factor, and simplifying shock builds meant Factory Kahne could customise its shocks quickly for very specific operating windows. Other manufacturers' parts had bigger ranges, but were compromised on overall performance. Again, Willie's experience as a crew chief was crucial because he knew how often the shocks were being rebuilt, and how the cars were being set up in parking lots between races, sometimes three or more times in any given week.

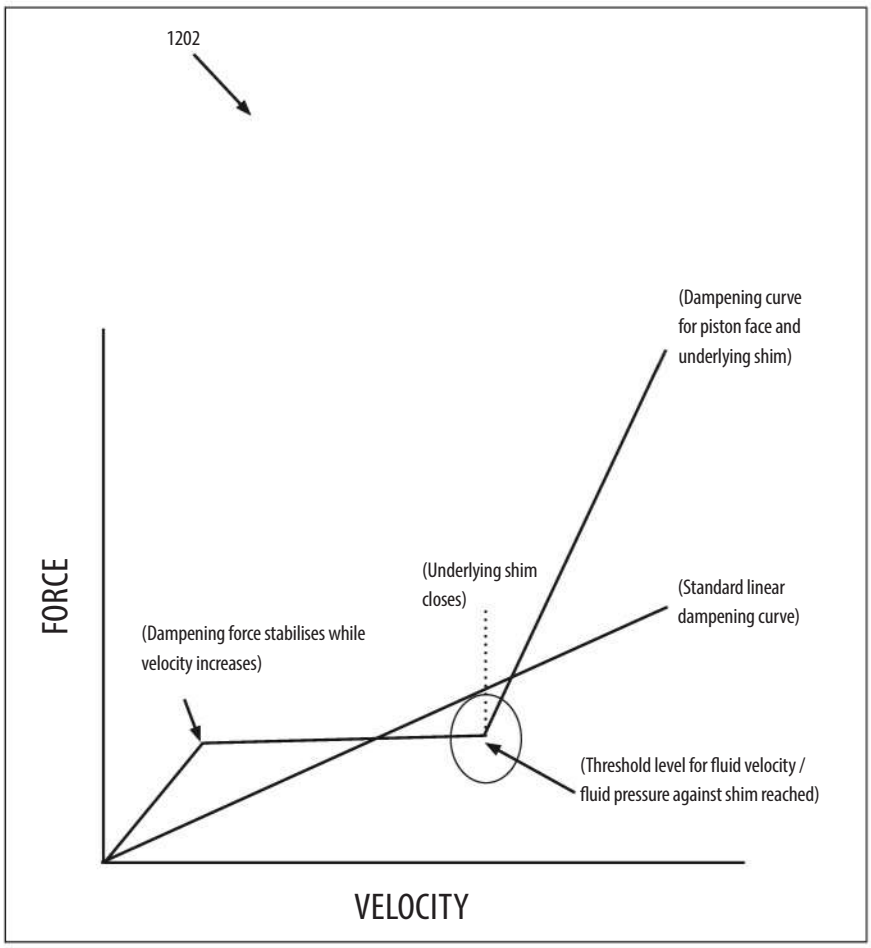
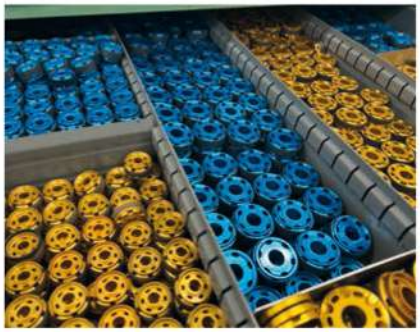

1202
(Dampening curve for piston face and underlying shim)
FORCE
(Underlying shim closes)
(Standard linear dampening curve)
(Dampening force stabilises while velocity increases)
(Threshold level for fluid velocity / fluid pressure against shim reached)
VELOCITY

Illustration from patent document 11009094 for the Factory Kahne Racing Shocks reactive dampening system plate

Once Factory Kahne built the best sprint car-focused shock it could, the company started adapting the design to fit other forms of dirt racing. Willie estimates Factory Kahne now has around 70 per cent of the dirt racing market in the US, in the categories of micros, midgets and sprint cars, while its products are also being used on sprint cars in Australia and New Zealand. So popular have they become that the company has now contracted dealers and service centres in both countries.

Dished innovation

The latest innovation from Factory Kahne is a device called the reactive dampening system (RDS) plate, which they patented in the US in 2021 under patent number 11009094. The plate is a dished device with multiple ports that mounts to the bottom of a piston and allows for a dished piston of a digressive design to act in a linear fashion when a shim is activated. The front face of the plate where a shim would mount has multiple ports, with one group of ports routed to the outer diameter edge in a pretty standard fashion,



Key to Factory Kahne's success has been its ability to quickly build custom shocks for very specific operating windows

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while the ports around the interior edge are oversized by a fraction of a millimetre.

The other side of the plate has a shim that sits at the peak of the underside and allows fluid to flow by until pressure is built to a measured spec, at which point the shim buckles and covers the three ports, allowing the shock go from a digressive curve to an aggressive linear one. That flat shim on the bottom can be sized to a variety of pressures, which controls when it will close and change the curve of the shock.

This development is significant in dirt racing when used on the right-rear corner as it allows for a shock that can quickly adapt to changing track conditions, especially on surfaces that are a combination of slick, packed dirt and holes and ruts. At faster shaft speeds in those ruts, the shock reacts and keeps the car stable, but then returns to its softer setting on the smoother sections when the shaft speed slows down, releasing the collapsible shim.

The clever design of the plate has allowed Factory Kahne to implement the architecture in every shock it builds, whether that shock is using the RDS plate or not, as it can simply be swapped for a standard one if the customer does not need the hybrid curve.

The technology also helps in testing as it is easy to compare set-ups by building the rest of the components identically and swapping between an RDS and a non-RDS shock quickly. This ease-of-use approach also extends to the adjusters and to the overall design philosophy of the Factory Kahne shocks, where Willie looks at the time needed to turn multiple compression and rebound adjusters, and the potential added components needed to maximise their benefits vs a couple of bolts to swap the entire shock unit.

Willie also shared that the company has found large temperature benefits by reducing the number of components inside their shocks and minimising the amount of additional hardware required to make adjustments. To prove the theory, Kahne experimented with a variety of adjustment mechanisms, including some that can be controlled by the driver, but, ultimately, the company focus remains on assembling the best possible shock combination for a specific race scenario.

Next steps

I asked Willie if he ever planned to go back to his roots and build motocross shocks. He says he continues to study motocross suspension to help him implement new ideas for his four-wheel customers, but doesn't plan to compete in that market.

Factory Kahne has been approached about building shocks for other forms of racing, ranging all the way up to IndyCar, but Willie says the company prefers to stick to what it knows and not expand too quickly. Its current development trajectory is on dirt modifieds as that's a natural extension of the current range and an area it can explore using the test-first philosophy, as one of Factory Kahne's shock technicians spends his weekend as a dirt modified crew chief, so is perfectly placed to test prototype units.

Kahne reckons his company now has around 70 per cent of the US dirt market, including micros, midgets and sprint cars

At faster shaft speeds in those ruts, the shock reacts and keeps the car stable, but then returns to its softer setting on the smoother sections when the shaft speed slows down, releasing the collapsible shim

So successful have Factory Kahne shocks been that Willie has been approached about building them for higher level series, including IndyCar. For now, though, he prefers to specialise in the dirt environment

In the early days, Willie built every one of the shocks that left Factory Kahne himself but, due to demand for the company's products, multiple shock build technicians are now employed, allowing him to focus mostly on research and development.

He says he looks at Honda Racing Corporation (HRC) as an example of how a racing company should function, and tries to follow a similar ethos, which is why he continues to build sprint cars and midgets and compete as a crew chief. He only does select races these days, but they all contribute to moving the technology at Factory Kahne forward, as well as allowing him to study how his customers use their shocks at the track.

Keeping that trackside presence strong, Willie has partnered up with dirt racer, Corey Day, to compete in a variety of one-off races and they've seen success, even while running on an R&D budget with minimal staff.

Chassis passion

One reason for that success comes from his other passion project, chassis building. Factory Kahne has partnered with Triple X Race Co to design and build a couple of versions of a customised sprint car chassis that offers compliance and improves safety for the driver. To test the design, an example chassis was built and put on a variety of test equipment before being raced in the real world. Once they had some notes, they went back to the drawing board and created a second version, which is what Willie is campaigning now with Day.

The Kahne / Day sprint car will likely be back out in 2026 but, at time of writing, the focus was on the USAC dirt midget as Willie will be crew chiefing Day at the Turkey Night Grand Prix at Ventura Raceway, California, before a likely return to the Chili Bowl Nationals in January, where Willie will surely be testing his latest prototype build.

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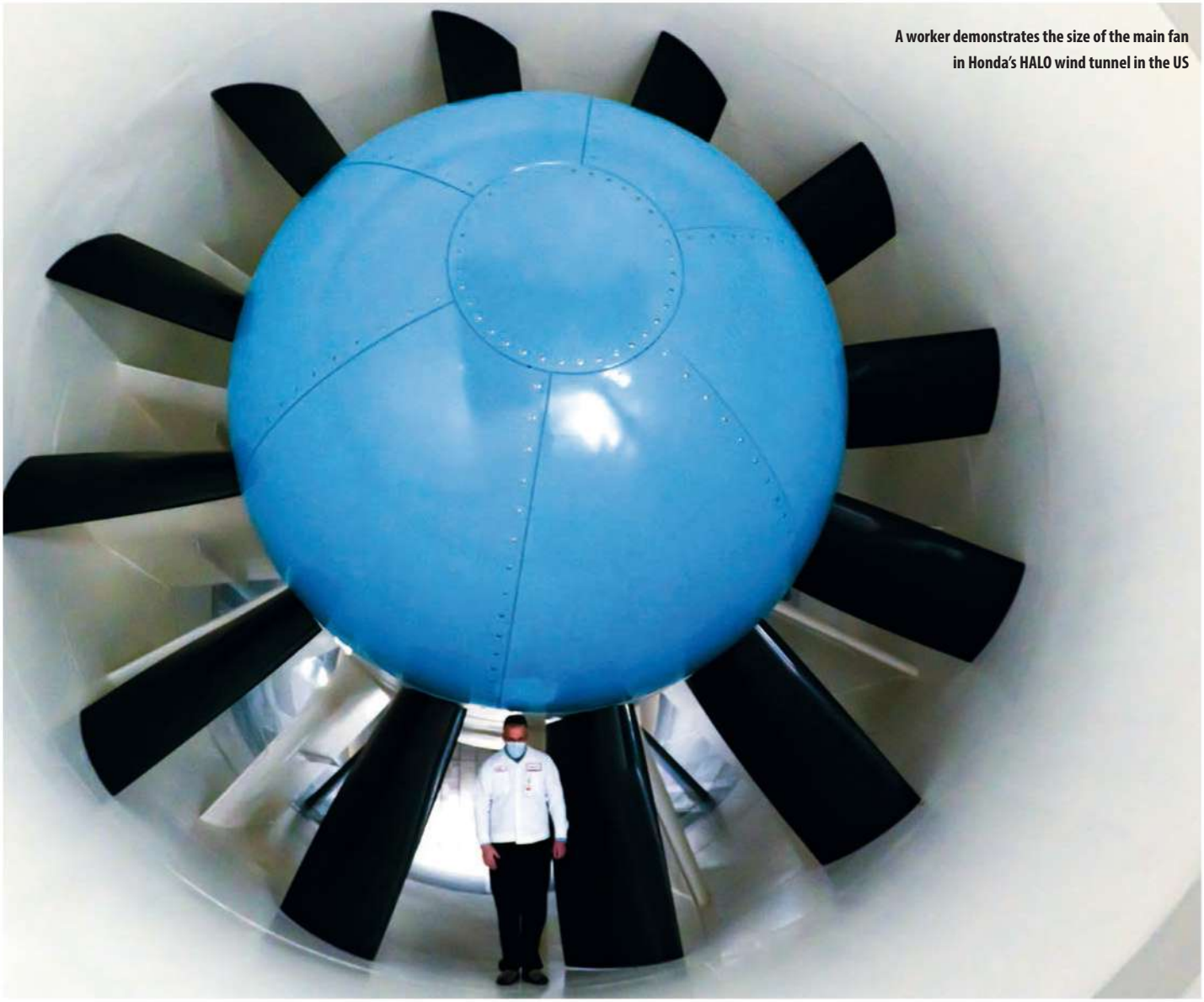


A worker demonstrates the size of the main fan in Honda's HALO wind tunnel in the US

Air quality

The pros and cons of the various types of commercial wind tunnel available for motorsport use

By LAWRENCE BUTCHER

For those old enough to remember, 2010 was the year Virgin Racing's VR-01 hit the Formula 1 grid. It was special because its aerodynamics had been developed solely via CFD, without the use of a wind tunnel. Fifteen years later, the vision of then Virgin technical director, Nick Wirth, that all cars will be designed and developed in the same way, using virutal reality and simulation techniques, hasn't come to pass, as wind tunnels remain a vital part of race, and road car, development.

That is not to say CFD hasn't advanced massively in the intervening years but, when it comes to honing the marginal gains needed to be competitive in top class racing, physical tunnel testing is still an indispensable element of the correlation triangle.

It's a well-known fact that wind tunnels are ferociously expensive, both to build and run. Although almost every F1 team now has its own, by regulation accommodating 60 per cent scale models, many OEMs have shared automotive / motorsport tunnel capabilities, meaning commercially available operations are very thin on the ground, particularly those with the capability to accept full-scale cars. So, what is the current state-of-the-art in motorsport wind tunnels, and what differentiates the various types of tunnel?

Tunnel types

Surprising as it may sound, nearly every automotive wind tunnel is considered 'low speed'. That's a relative term, with tunnels classified as subsonic, transonic, supersonic

and hypersonic. Subsonic means speeds below Mach 0.8, which at sea level is around 600mph (980km/h). For most dedicated automotive tunnels, wind speeds tend to top out at around 300km/h, though it's worth noting here that wind speed is normally measured in metres per second, so that equates to 85m/s. Many operate at a lower speed than this, especially if their primary function is for road car development.

Designs can be split into two main groups, open and closed circuit. The former, as it sounds, has an open airflow circuit, meaning air is drawn into the tunnel from outside, channelled through the test section and exhausted back to the atmosphere. The second type features a closed loop where air is constantly circulated around and through the test section. The earliest wind tunnels were open section and are also known as Eiffel (after the French engineer of the same name) or NPL (National Physics Laboratory, the UK site that first used this layout).

Open circuit tunnels have several advantages, not least they are cheaper to build, and are favoured for some aerospace applications where their design makes it easier to handle hot exhaust plumes from gas turbines. They also have disadvantages, though, such as trickier flow conditioning in the test section and susceptibility to external environmental conditions.

When it comes to full-scale car testing for motorsport and high-performance applications, closed-circuit tunnels, where the air is circulated through a closed loop, are the norm. They provide greater control over the air flowing through the test section, both in terms of flow conditioning and environmental control such as temperature and humidity. They are also more efficient when producing higher wind speeds as the fans do not need to constantly accelerate the air from a static condition. This means they are quieter in operation (not such a concern for racing, but very useful for aeroacoustics testing in general automotive). Nearly every serious motorsport wind tunnel, whether for scale model or full-scale testing, is closed loop.

There are two main types of test section used, open and closed. The former is the preferred option when absolute performance is desired

Test sections

In either a closed or open loop tunnel there is a test section where the vehicle under study is located. Again, there are two main types of test section used, open and closed. The former is the preferred option when absolute performance is desired.

In a closed section tunnel, the test section is close in dimensions to the inlet from the diffuser (used to accelerate flow into the test area) and the outlet. There is not a hard and fast rule of this dimensional relationship. The Aerodyn tunnel in Mooresville, NC, for example, is a closed section design, but the walls of the test section barrel out to provide some space for flow structures around the sides of a car. This is called a contoured wall.

It is this latter factor that makes open section tunnels more desirable, particularly when dealing with vehicles with lots of outwashing or upwashing aerodynamic devices, F1 cars being an obvious example here. Here, the 'blockage ratio' of the wind tunnel becomes important. In simple terms this is the ratio of the frontal area of the test vehicle compared to the cross-sectional area of the test section, normally expressed as a percentage. Ideally, this wants to be as low as possible, around 10 per cent.

Obviously, the larger the vehicle, the greater the size of the test section needed to keep this ratio low. Hence why open section tunnels, where the test section is much wider and taller than the rest of the circuit, are desirable. However, even with open section tunnels, there are differences in size.

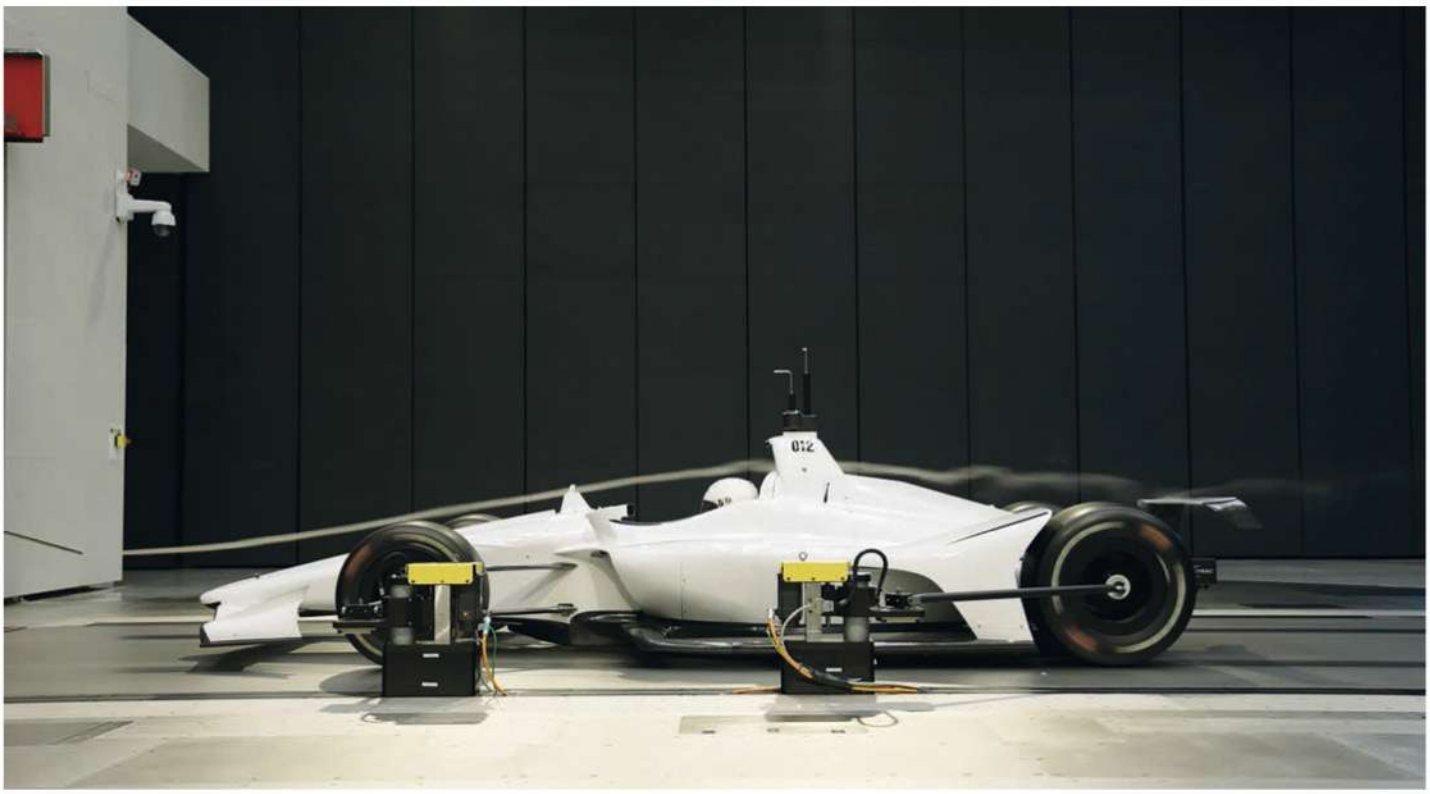
Some tunnels can be run as either a closed section or open section, though these normally have a relatively small open section and, when a full-size car is put in it, the blockage ratio can still be less than ideal. There are several problems that can arise here: the restriction between the car and the tunnel walls accelerates the airflow, increasing local dynamic pressure and producing inflated aerodynamic forces; the wake coming off the vehicle can be restricted, again having an effect on measurements; and the boundary flow of the walls and ceiling can start to interact with the flows around the vehicle. If you want to yaw a vehicle within the test section, these problems are amplified.

Over the years, various tools have been developed to help reduce the impact of blockage, the main ones being slotted and adaptive walls. The first of these lets air bleed

Automotive wind tunnels either have a single moving ground plane, as seen here, or individual ones under each wheel. The ability to rotate the base plate allows for testing in yaw

Scale and full-size models are used during aerodynamic testing programmes, though not all tunnels can accommodate both. Some series, such as F1, stipulate the size of test models allowed

You can see the individual MGPs in this tunnel, including one under the centre of the car, as well as the fixings beneath it that allow precise control of the ride height



Perhaps surprisingly, the walls of the test section of a wind tunnel are also a critical component. To reduce the impact of blockage, slotted, adaptive and flexible walls have all been developed

off through the walls of the test section, reducing pressure buildup around the sides of the vehicle. The second approach allows the walls of the tunnel to be 'flexed' to change their shape, depending on the flow fields around the vehicle. Though both techniques can help reduce the effects of blockage, they cannot eliminate it, and the effects of blockage still need to be accounted for when deducing absolute figures from a test.

The ultimate answer is to have a test section so large that blockage is simply not an issue, which is exactly what the highly advanced facilities such as Windshear and Honda's HALO wind tunnels in the United States, plus a few others in Europe and Asia, feature. With these tunnels, the test section is of sufficient volume that the most extreme upwashing and outwashing aero on full-size vehicles can be accommodated, even in yaw conditions. The downside of such tunnels is their sheer size, and hence cost. There can also be challenges around phenomena such as 'pulsing' of the airflow within the test section, particularly at higher speeds. For example, in the case of Honda's HALO tunnel in Ohio, an anti-resonance plenum chamber is used to mitigate these pulses.

The loop of a closed circuit tunnel will feature flow straighteners, turning vanes on the corners and boundary layer bleed slots

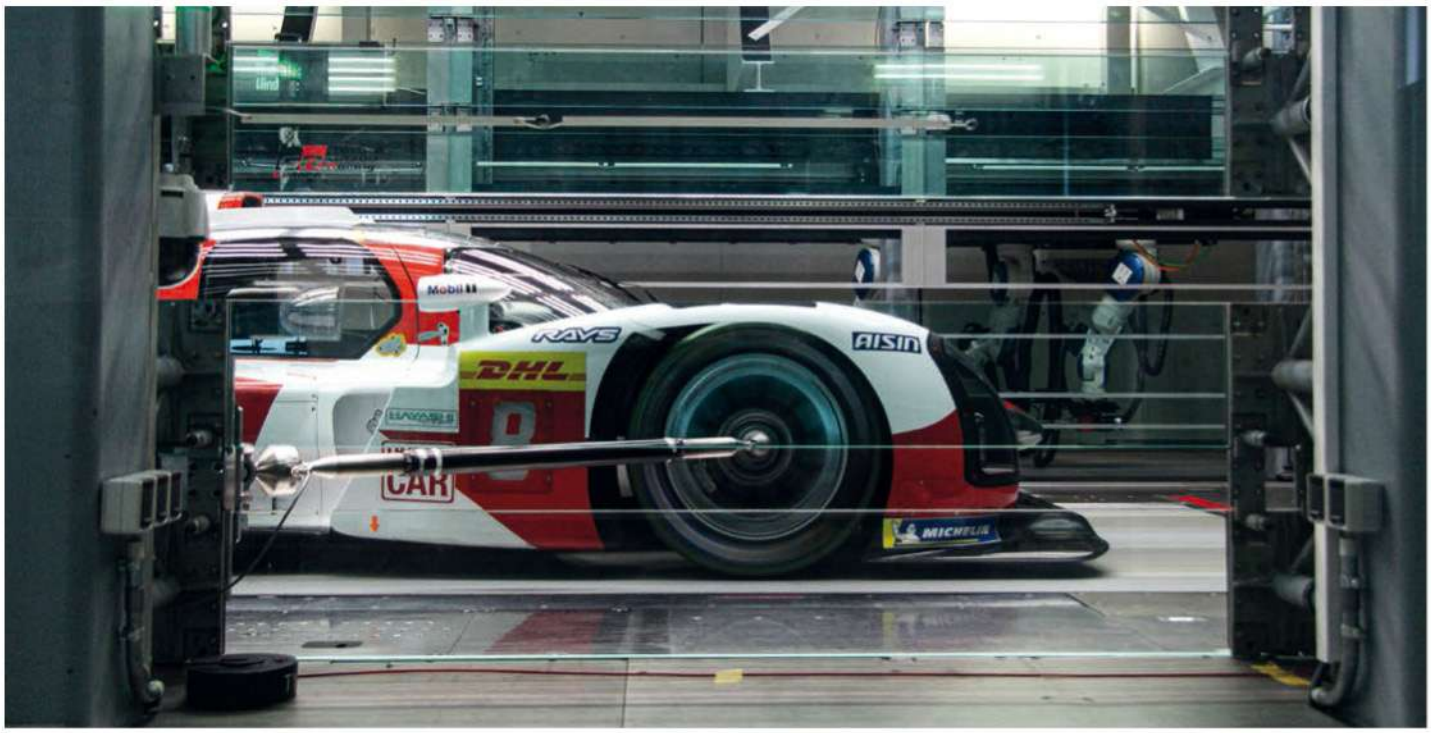
There are many other devices used to optimise flow conditions, all with the intent of producing reliable, repeatable results.

The airflow entering the test section wants to be as uniform as possible, directionally stable and with low turbulence. For example, the loop of a closed circuit tunnel will feature flow straighteners, turning vanes on the corners and boundary layer bleed slots. The latter is used to thin out the thick boundary layer that forms as the air is accelerated through the nozzle of the wind tunnel into the test section.

Rolling roads

The primary difference between automotive and aerospace wind tunnels is the need to realistically replicate the behaviour of the vehicle running close to the ground. The only realistic way to do this, at least for racing applications, is with a rolling road within the test section, known as a moving ground plane (MGP). In the past, fixed floor tunnels were commonplace, and some, such as Aerodyn, feature a boundary flow control system to replicate a moving floor. However, every F1 team, and all OEMs, have access to rolling road-equipped tunnels.

Not all MGPs are created equally. For most mainstream automotive applications, what is known as a five-belt system is normally employed. This uses a single narrow belt under the centreline of the vehicle, with a smaller belt under each wheel. For production car work, and a decent proportion of racecar development (think GT cars), this is sufficient, providing a close-to-realistic representation of



Capable of running a full-scale car in the tunnel, TGR Europe's facility is more commonly used for 60 per cent scale Formula 1 testing, and Cadillac has become a very busy customer there

Even though a moving ground plane is far superior to a fixed floor, it can still produce spurious load measurements due to the interaction of the air with the belt

Windshear in the US is unique in that it has the ability for multiple teams to use the facility concurrently yet in secret

the interactions between the underfloor flows and the ground, while also allowing for the capture of flows from the rotating tyres.

Another positive of a five-belt system is cost, the five smaller belts are cheaper to build and maintain than a single, wide belt. The downsides are that the gaps and slots between the individual belts means there are flow discontinuities under the floor, not ideal when studying cars with ground effect.

This brings us to the big daddy of them all, the single belt system for full-size car testing. Here, it is worth looking at the example of the MGP fitted at the Honda HALO facility (which is very similar to that found at Windshear). A novel feature of the HALO tunnel is that is has a swappable MGP with both five and single belt options available, with it taking around four hours to change between systems. The single belt is 3.2m across, accommodating even the widest racecars easily, and 9.5m long. It can run at up to 310km/h and is mounted on a turntable permitting the vehicle to be yawed.

The belt itself incorporates a force measurement system, which uses a six-component balance under the wheel contact patches, while the vehicle restraint system also incorporates load cells. It should be noted that even though an MGP is superior to a fixed floor, it can still produce spurious load measurements due to the interaction of the air with the belt, and features such as wipers are used to isolate the belt from pressure generated by the test vehicle.

Distinguishing factors

There are many other factors that distinguish one wind tunnel facility from another. For example, there are considerations like confidentiality. This is where Windshear is unique in that it allows multiple organisations to operate concurrently without ever actually seeing each other, thanks to a total of six race bay-type preparation areas and a system that allows for covert movement of vehicles around the facility.

There is also the matter of throughput, or the amount of testing that can be achieved in a given time. As one expert consulted for this feature noted, certain tunnels take longer to acquire data on each run. This can be down to the time needed for the wind to be started, conditions to stabilise and data be gathered and downloaded. This impacts how many configurations can be tested in a day and, in turn, cost.

Other factors include additional capabilities beyond straightforward aerodynamic mapping. One example is the use of particle image velocimetry (PIV) techniques, which can be employed for detailed investigation into flow structures. Then one has varying types of ride height adjustment systems, which allow for a test vehicle to be run through a full sweep of ride

Controlling airflow can be done in different ways according to tunnel design. TGR Europe has slatted walls to reduce blockage around the car and has a full width rolling road

All the major OEMs have their own wind tunnels (BMW shown), though very few are available for commercial use

heights to build up a comprehensive aero map. Again, some systems are faster to set up than others, or more versatile in operation.

Unsurprisingly, given their cost, wind tunnels that can accommodate full-size racecars, with enough space in the test section to minimise blockage effects, and single-belt MGPs able to run at around 300km/h, are rare. While several automotive manufacturers have in-house facilities in Europe, they are not commercially available.

There are other tunnels that nearly meet the needs of high-end motorsport teams, and have been open to commercial use, such as Toyota Gazoo Racing Europe (TGR-E) in Germany, and the Pininfarina tunnel in Italy, However, both have compromises for race teams. In the case of TGR, full-scale cars cannot be run in yaw due to the lack of a turntable, while Pininfarina lacks a full-length MGP. The nascent Cadillac F1 team currently has exclusive usage of the Toyota tunnel.

Currently, it would seem there are only two commercially accessible tunnels that hit what could be called the 'gold standard' for motorsport wind tunnel testing, Windshear and HALO. This means that for work such as BoP testing in the IMSA Sportscar Championship and the FIA World Endurance Championship, these are the only viable options. The FIA previously used Sauber's wind tunnel in Austria but, since the Audi F1 programme commenced, this is no longer available. Additionally, HALO also comes with the caveat that it is manufacturer owned.

For the time being at least, then, the US is the destination if you want the final word in aerodynamic development capabilities.

Alternative tunnels

Straight-line testing for aerodynamic development and validation is nothing new, and manufacturers have conducted such runs for decades. However, even on the most perfect day, it is difficult to ensure repeatable conditions from run to run. But what if you could run the car in a completely controlled environment such as, well, a tunnel?

There are currently two such sites in the world where this can be done, the Laurel Hill Tunnel in Pennsylvania, USA and the Catesby Tunnel in the United Kingdom. Laurel Hill was developed first, in the early 2000s, but it is not currently available for commercial use.

The Catesby Tunnel, on the other hand, opened for business in 2021. Originally built as a railway tunnel in the 19th century, the plan to turn Catesby into an aerodynamic test facility was hatched in 2013. In its finished form, the tunnel features a 2.7km test section, spanning 8.2m and 7.8m high, with turntables at either end allowing for quick turnaround of vehicles. Thanks to the controlled atmosphere within the tunnel, repeatable test runs can be performed at lower cost than in a full-scale wind tunnel. Also, as it uses a real road surface, rather than a moving belt, and cars travel along it, Catesby allows for the investigation of factors that would be impossible in a wind tunnel, such as wake formation a long distance back from a vehicle.
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Racecar ***visits UK-based race fuel producer and importer, Anglo American Oil Company, to uncover the secrets to brewing top-quality motorsport fuels***

By MIKE BRESLIN

Anglo American is involved in many motorsport categories. Here, its Volvo 740 drift car helps to publicise some of the company's primary products

These days, the cars in many motorsport series will happily glug pump fuel for lap after lap, but there are still a significant number that require a more finely distilled fuel, whether because of the specification of the engine or the age of the racecar. This is where dedicated motorsport fuel producers and suppliers, such as Poole, UK-based Anglo American Oil Company, come into the picture.

While its name points to a transatlantic relationship that's at the heart of this business, Anglo American's story actually originates in Sweden, where company founder, Anders Hildebrand, started racing in the 1990s to prove the potency of the Ford GT40 replicas he was then building.

It was at this time that Hildebrand's first connection with American fuels and oils was established, through a sponsorship deal with 76 Lubricants. However, at that stage he was not working in the fuel and oil industry. Indeed, at university he had studied engineering, marketing and economics – a near perfect combination of subjects for a career in motorsport.

It was largely because of his connection with GT40-style cars that, later in the 1990s, Hildebrand moved to Poole and became heavily involved in the Spectre R42 supercar project, a car that had a similar design philosophy to Ford's Le Mans classic. That venture fizzled out due to lack of investment but, by 1999, Hildebrand had rekindled his relationship with 76 Lubricants, which had been looking for a distributor in the UK and had found a willing accomplice in the Dorset-domiciled Swede.

Anglo file

Initially, Hildebrand found it difficult to sell the American oil into the regular garage and servicing market, but by now he was racing again – a frontrunner in the highly competitive Renault Spider and then TVR Tuscan championships – and through his presence in UK paddocks, he started to build up a market in motorsport.

At that time, the company was focused on lubricants, but then, after a significant investment in a large stand at the 2000 Autosport International show, there was a bit of an epiphany. 'Five guys wanted to talk about oil,' Hildebrand recalls. 'I think I managed to sell to three of them. But I had put up a very small sign saying 76 race fuels now available, and I was swamped with interest. I ended up selling a whole container of race fuels that weekend! Then I sold another container later that year. If I advertised oil, no one rang. If I advertised fuels, the phone didn't stop ringing. I felt someone was trying to tell me something.

'Then I got wind that British GT was going to introduce a control fuel in 2001. I went to talk to Stuart Higgs at the BRDC [British Racing Drivers' Club], and I had a big rendering of how my race fuel truck would look. Of course, I didn't have a truck then!

'If I advertised oil, no one rang. If I advertised fuels, the phone didn't stop ringing. I felt someone was trying to tell me something'

Anders Hildebrand, founder of Anglo American Oil Company

He was duly impressed, and we got the fuel contract. In 2002, we got British F3, and then the SEAT Cupra Championship and Radical, and then others followed.'

Strength in numbers

Since then, the company has gone from strength to strength and still supplies fuel to British GT, GB3 and others today, while it has progressed beyond that rendering to its own fleet of trucks that are a regular sight at circuits across the UK. However, it's important to note here that, despite its beginnings, Anglo American is much more than just a fuel importer. From quite early on, the company realised it needed to adapt its fuels for the UK market, in order to conform to the FIA regulations for race fuel.

'The problem we had with 76 was that they were not interested in making FIA fuel for this market,' Hildebrand explains. 'So we had to find a solution where we could use the 76 race fuels made for the US as a base stock and then blend them into FIA fuels.'

This was initially achieved through a partnership with F1 fuel company, PetroScience, but a bigger issue came along in 2003 when 76 decided it was no longer interested in supplying to motorsport. Ultimately, though, this led to a partnership that has been at the heart of the Anglo American success story for over 20 years now.

'Throughout my journey with 76, they always said that the only other fuel supplier that made good, consistent race fuels in America was Sunoco,' Hildebrand recalls. 'Sunoco didn't have anyone in the UK, or in Europe. So I rang the general manager and, within a week and a half, I was on a plane to Philadelphia. I made a presentation to the management of Sunoco Race Fuels, and they've been great partners since 2004.'

Today, Anglo American not only stocks Sunoco, but is licenced to design and blend Sunoco-branded race fuels at the company's Poole facility. There are now 30 different fuels available from Anglo American, over half of which are its own formulations.

Blend line

As far as the design of these fuels is concerned, this relies a great deal on Hildebrand's own experience, while the company also has a particular approach to fuel testing: 'It's knowing what different fuels contain, and what they do, and it's based on experience of what the different types of engines want,' Hildebrand says. 'It's also being hands-on, testing fuels at circuits, working with teams. This gives me an understanding, or a feel, for what we should put in the fuel to make it work. There are other companies that test more fuel in labs, but that's a completely different environment. We do well over a thousand fuel tests a year at circuits.'

Anglo American supplies Sunoco control fuel to British GT (shown) and other national race series, such as GB3 and GB4

The company has a fleet of fuel trucks, which are a common sight at race circuits across the UK during the season

Company founder, Anders Hildebrand, with Angelo R Drive – a magazine cartoon featuring the hapless racer was a key advertising tool for Anglo American Oil Company for many years

'There are other companies that test more fuel in labs, but that's a completely different environment. We do well over a thousand fuel tests a year at circuits'

Anders Hildebrand

Hildebrand is a confirmed petrolhead, the ex-Renault Spider and TVR Tuscan racer using this 400bhp 1972 Chevrolet C10 as a daily driver / rolling advertisment for his company's products during the summer months

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'We need to put [the components] in in the right order so they diffuse into each other naturally. But we also circulate the fuel to make sure it has been properly blended'

Anders Hildebrand

Most of the fuel components come from oil refineries, where they are 'cut' from crude oil as it is processed, although some, such as sustainable components, come from other sources. Whatever their origin, to develop or to produce a race fuel, these need to be blended, along with the chemical additives, and that takes place in two huge blending tanks. It's not just a matter of simply mixing a cocktail of liquids though.

'You need to do it in the right order, when you blend it, to make sure you don't get separation,' Hildebrand explains. 'The chemicals are different weights. So, naturally, the heavy chemicals want to be at the bottom. We need to put them in in the right order so they diffuse into each other naturally. But we also circulate the fuel to make sure it has been properly blended.'

The blending tanks used for this process are made of 316 stainless steel and can hold 42,000 litres. They are dished at the bottom to help the fuel swirl as it's mixed with the assistance of large external diaphragm pumps. Once the blending process has finished, the tank is drained, except for the last 250 litres at the bottom, so this can be checked for contaminants. After this, the blend is subjected to a rigorous quality control process, using infrared spectrometers, which analyse how the molecules in the fuel absorb wavelengths of infrared radiation.

The company's two blending tanks are made of high-grade 316 stainless steel and can hold 42,000 litres of fuel. They are dished at the bottom to help the fuel components mix well during the blending process

Batch perfect

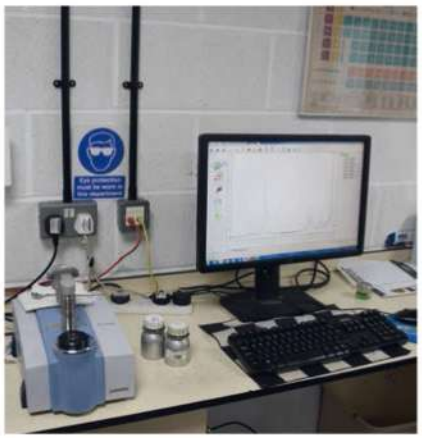
'We take samples,' Hildebrand continues. 'It's basically a probe you send down and then you click a button and it opens and fills at the level you want from the bottom, middle and top. That then goes into the lab and we check it to make sure all the samples are the same. If they are, that means the mix is good.

'We then compare that to previous batches to make sure the blend is good, because it could be that the mix is perfect, but we're actually a bit low on oxygen levels, or too high on aromatics, or whatever. Then we can adjust it. If we adjust it, we then mix it again and we sample it again, until we are 100 per cent certain that it's right.'

As well as the two blending tanks, there are also four storage tanks that each hold 33,000 litres, plus a filling station, of sorts, where the blends are decanted into drums before going into a 16,000sq.ft (1486sq.m) warehouse. This structure needs to meet tight safety regulations, which include suspended walls with an air gap at the bottom so heavier than air vapours can escape.

Not that there are ever any errant wisps of vapour at Anglo American. If there were, they would be picked up by the hydrocarbon 'sniffers' – sensors attached to the walls all around the warehouse – and an alarm would sound. There are also sniffers on the electric forklifts and, if they pick up any trace of hydrocarbon, they immediately stop.

In the highly unlikely event there is a fuel spillage, this would be contained within the warehouse by humps and sills at entrances.



Finished fuels are checked after blending using spectrometers, which analyse how molecules in the fuel absorb wavelengths of infrared radiation

Petrol is decanted into manageable size drums at this pumping station. There are currently 30 different fuels available from Anglo American, over half of which are its own formulations

Race-ready fuel is stored in drums in the company's specially designed warehouse, the walls of which are suspended from a metal frame to allow any heavier than air vapours to escape

These are only a couple of centimetres in height, because even a 1000-litre drum doesn't make much more than a shallow puddle if spread over a 16,000sq.ft area. Finally, no mobile phones are allowed in the warehouse so, even if there was a leak, the risk of a spark is minimised.

Special brew

Much of the product from this warehouse will be used by championships as control fuel. Interestingly, even though the product will be the same across a grid, and eligibility of the control fuels it supplies is also tested by Anglo American, there is still a certain amount of tailoring of the specs to suit a particular series.

'It's a matter of what engine it is, what compression ratio, whether it is turbo or naturally aspirated. Also, what is the level of protection they need for the engine? What level of sustainability do they want? Do they want fuel that increases the power, or is safeguarding the engine more important?

'We are hampered with the pureness of the fuels by FIA regulations. We could have no regulations and just make the best, clean burning, lowest emission fuels'

Anders Hildebrand

'For sustainable fuels, we can increase power, but then you must increase the oxygen level, and then the engine will run leaner if not re-tuned. So, is the trade-off worth it?'

Some series allow the use of full-on race fuels, and naturally these do tend to be more expensive, which means some people might be tempted to take a shortcut and use an octane booster in a regular fuel. But this, Hildebrand warns, somewhat misses the point of a race fuel: 'Basically, pump fuels are designed to be as cheap as possible. You go to the refinery and you take a big cut. You have hundreds of different hydrocarbons. Some very good, some not so good, and in a modern road car engine they work quite well. But a race fuel is built from the ground up using stable and narrow refinery streams, plus higher quality chemicals. Although you can achieve the same octane numbers with an octane booster, it would never beat a bespoke race fuel in terms of consistency and protection, and cleanliness inside the engine.'

On that matter, the octane level mandated for FIA-approved race fuels is a source of some frustration for Hildebrand: 'In Europe, the octane numbers are restricted to 102, whereas in America they have no restriction. And of course, the more octane, the more protection you get from detonation, so you can build more efficient engines. It is a bit of a shame, as it's actually harder to make a low octane fuel, because the good ingredients that you want to use, they are higher octane. We are hampered with the pureness of the fuels by FIA regulations. We could have no regulations and just make the best, clean burning, lowest emission fuels.'

Historic challenge

Anglo American is particularly visible on the historic motorsport scene, supplying a plethora of clubs like the Historic Sports Car Club (HSCC), plus events such as those run at Goodwood. But older cars present a challenge when it comes to the fuel they use, chiefly because they often will not have ECUs.

'It is more of a challenge,' admits Hildebrand. 'If you look at British GT, for example, most of the modern GT cars can run on 102 octane, or super unleaded. Obviously, they run better and safer on 102, but they have a map so, if they go testing and there's no 102 fuel available, they can still run using normal 97 or 99 octane.

'The historic engines don't have that re-map facility. They can retard the timing but, if it's an engine designed for racing, when you retard the timing it will start to run hot, because you get a lot of fuel that is not burnt, so you get elevated exhaust temperatures. That also reduces the engine's resistance to detonations. The historic engines are much more finicky when it comes to fuels.'

The less tightly sealed fuel systems of historic cars can also be affected if ethanol blended pump or race fuels are stored in the tank for any length of time, because the ethanol will absorb moisture from the air, which ultimately causes corrosion. It's no good just draining the system either because then the seals start to dry up and will eventually need replacing. Because of this, Anglo American markets ethanol-free 'storage fuels' through its Classic Fuel Solutions brand.

Anglo American is also well known for its sustainable fuels, largely because it supplies cars at Goodwood's events with fuels containing 70 per cent sustainable components, a precise phrasing Hildebrand is keen to stress: 'At Goodwood, we're not saying we're using fuels that are 70 per cent sustainable. We say that the fuel is made from products that are themselves made from 70 per cent sustainable components.'

Incidentally, Anglo American does produce a methanol race fuel that is 99.85 per cent sustainable, the remaining 0.15 per cent being the denaturant that has to be put in both methanol and ethanol to make it smell bad, so – believe it or not – people aren't tempted to drink it!

At the present time, Hildebrand is not sure the wider club and national-level motorsport scene is ready for sustainable fuels, largely because of the costs involved – something that is borne out by Motorsport UK's decision to postpone its plans to mandate the use of fuels with at least 50 per cent sustainable components from next year in series that currently use, or allow, racing fuels.

'There's always that monetary side,' acknowledges Hildebrand. 'Racing is expensive, and it's becoming more and more expensive. If there are two fuels, and one is sustainable, or part sustainable, and one isn't, but that sustainable fuel costs £7 a litre, and the other costs £1.30. Well, for the club racer, this might be the difference between actually being able to go racing. Events like Goodwood, where you're invited, everyone wants to do it, so it's not a big issue. The guys racing those cars, they have got money.

'The only way to introduce sustainable fuels is through championships; for them to say you *have* to use this fuel. But I think it's too early, because there are not enough sustainable components available on the market to make them affordable. We can do whatever anyone wants, but we then have to have that conversation with championships. We ask, shall we take a step? And they say, what's the cost? When we tell them they say it's too expensive. So, okay, we wait until it gets cheaper.'

Good optics

The important thing for the moment is that motorsport is *seen* to be doing something, which is why Hildebrand agrees that it's good that high-profile events like Goodwood are embracing using fuels with sustainable components. However, it's a drop in the ocean when it comes to any real effect on the environment: 'There are 130,000 people coming to Goodwood in, maybe, 60,000 cars. They're probably going to drive, on average, 180 miles each,' he says. 'Compare that to maybe 200 cars racing on track. Still, it is a way to show what can be done.'

Driven to win

It's not just fuel at Anglo American, and the company is also the UK, European and Middle East distributor of Driven Racing Oil, a brand originally founded by NASCAR powerhouse, Joe Gibbs Racing (JGR). This all came about in the early 2000s after JGR's then supplier, 76, changed the makeup of its race oil, adding more detergents, which affected its performance. This was, in some ways, a portent of the way road car oils have diverged from racecar oils in subsequent years, especially those used for historic race engines.

'They are focused on long service intervals, and they are for cars that are driven at very moderate pace,' says Hildebrand of modern road car oils. 'They are great for environmental standards, and also reduce fuel consumption, but they are likely to be very thin oils. And the engines are designed for that. Whereas, for a historic engine, those engines have much bigger tolerances, so typically need a thicker oil.'

Also typically, specialist race oils contain less detergent. 'In a good race oil, you have a little bit of detergent, because you want it to be clean, but you have much more anti-wear additives, such as zinc, phosphorous and sulphur. Whereas in the road oil, you have the opposite, few anti-wear additives and lots of detergent. But you need the anti-wear additives in racing, simply because of the higher revs, loads and temperatures.'

Rather like wine, the quality of a non-synthetic base oil depends on the ground it comes out of

Anglo American has supplied many of the historic racecars that compete at the Goodwood Revival and Festival of Speed in the UK with race fuels that contain products made from 70 per cent sustainable components

Preferably, of course, these anti-wear additives will be of good quality. For instance, Driven race oil contains zinc dialkyldithiophosphate (ZDDP), which is a polar molecule and is therefore attracted to metal surfaces.

There are also multigrade additives to consider. These are polymers that are added to reduce the thinning of the oil when the engine becomes hotter; oil thins with heat. 'In a road oil, they need to be cost effective, so they will not use the best, the sturdiest, multigrade additives,' Hildebrand says.

Driven oils, Hildebrand tells us, have better quality multigrade additives, and also a better base oil. Interestingly, rather like wine, the quality of a non-synthetic base oil depends on the ground it comes out of. If you're wondering, Pennsylvania oil, which actually comes from across the Appalachian Basin, is supposed to be the finest, and this is what is used in Driven GP-1.

GP-1 is a semi-synthetic oil, but much of the Driven range is fully synthetic, partly because such oils have a greater specific heat capacity; the cooling properties of an oil are vital when it comes to motorsport use.

Apart from the Pennsylvania mineral base oils, Driven uses mPAO (metallocene polyalphaolefin) as its synthetic base oil, as this has an extremely high viscosity index, double that of most mineral base oils. This results in exceptionally stable race oils, which in turn mean thinner oils can be used.

Branching out

There is still more to Anglo American than just motorsport fuels and oils. The company also supplies aviation fuel through the Warter brand, is the UK agent for Aspen garden machinery fuels and oils and markets Sonax car care products, BMC Air Filters and Zestino drift tyres in the UK.

Fuel and oil are still very much at the heart of the business, though, so what about the future for the company? After all, oil is sometimes referred to as dinosaur juice and, if some were to have their way, it too would shortly become extinct.

Hildebrand is confident there is a place for Anglo American in the years to come, not least because of the continued divergence of the vehicles we use on the road from those used on track: 'I think we're going to continue to specialise,' he says. 'I can't see in five years, or even 30 years, the Mustangs or the Shelby Cobras at Goodwood are going to be having electric motors. That's never going to happen. So, the niche market is probably going to get stronger. If it's going to be all EV cars on the road, there's not going to be any petrol stations as we know them, and that too will make our market stronger.'

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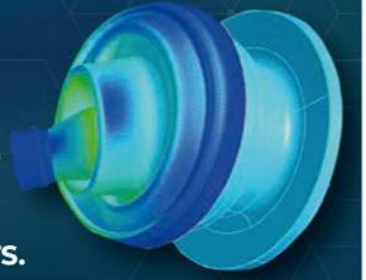

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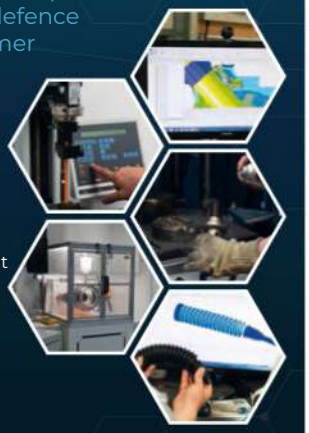

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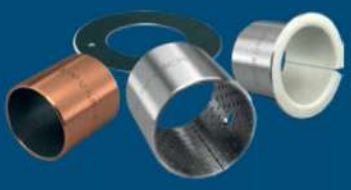

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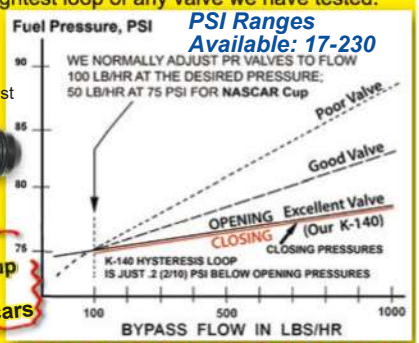

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Mountain range

A first detailed look at the new electric rally car from Alpine

By ANDREW COTTON

French car manufacturer, Alpine, has developed its first all-electric rally car, the A290 Rallye. It is due to make its competition debut at Rallye de l'Indre on 8 November and is available now to order.

Designed to meet the FIA eRally5 regulations, and the stringent safety measures that encompasses, the car will initially compete in a one-off event. That will give Alpine the opportunity to prove its performance in real-world conditions, as well as test the charging system and fine tune the sporting format, ahead of its 2026 roll out. It will then compete in the Alpine 290 Rally Trophy and the Alpine 290 Regional Trophy competitions. The former will support the French Rally Championship, while the latter caters for teams wishing to compete in regional events or hillclimbs under the French Federation of Automobile Sport (FFSA) banner.

The Alpine 290 Rallye is based on the A290 production car that follows the trend of small, lightweight electric runarounds, primarily designed for urban environments. Comparable cars are the Honda e and the new Renault 5.

Test process

Alpine's engineers started with the base car, which already featured a low centre of gravity thanks to the floor-mounted battery pack.

Initial calculations allowed the engineers to develop the vehicle dynamics and battery thermal management, accounting for energy constraints, before any hardware was built. Prototypes were then tested on different surfaces to assess the endurance of the running gear, while ensuring stable energy regeneration and optimising the ABS system.

After this, a series of tests to refine the car saw it cover more than 3000km in various driving conditions. During this process, Alpine Racing made several improvements, starting with the running gear and a dedicated suspension fitted with ALP Racing Suspension dampers to optimise vehicle control under rallying conditions. The dampers allow the ride height to be easily adjusted, making the car adaptable for all types of terrain.

The A290 Rallye has also been fitted with special steering knuckles to allow camber adjustment, along with bespoke springs, anti-roll bars and suspension components with increased stiffness to ensure optimum chassis stability in the extreme conditions the car will compete in.

Braking is by way of six-piston monobloc calipers and oversized 350mm discs at the front, single-piston calipers on 280mm discs at the rear and an integrated hydraulic handbrake. The car's ABS has been specifically

The car's cockpit is designed to be ergonomic and straightforward to use for drivers who might be at the early stages of their rally careers

The project started in late 2023, with simulations and prototyping taking place the following year. Real-world testing started in March '25

TECH SPEC: Alpine A290 Rallye	
CHASSIS	
Chassis	Alpine A290 with FIA rollcage
Front axle	MacPherson
Rear axle	Multi-link
Suspension	ALP Racing Suspension dampers
DIMENSIONS and WEIGHT	
Length / width / height	3997mm / 1823mm / 1502mm
Wheelbase	2534mm
Front / rear tracks	1576mm
Dry weight	1530kg
MOTOR	
Type	6AM
Maximum power	220bhp (160kW)
Maximum torque	300Nm
Electronics	GEMS adaptation electronic box
Battery capacity	52kWh (400V DC)
TRANSMISSION	
Type	Specific fixed reducer ZF-type, limited-slip, self-locking differential
BRAKES	
Front	Six-piston monobloc calipers / 350mm discs
Rear	Single-piston calipers / 280mm discs
Handbrake	Hydraulic
WHEELS	
Rims	EVO Corse 8 x 18in
Tyres	18in Michelin Pilot Sport A
INTERIOR	
Bucket seats / harnesses	Sabelt
PRICE	
Car assembled, painted and delivered with standard tyres (excluding options)	€59,900 + VAT

developed for the A290 Rallye by Alpine Racing, the company's motorsport division.

A 220bhp / 300Nm power unit transmits its output to the front axle via a ZF-type limited-slip differential. The reduction gear and electronic management have been redesigned for rallying, with regeneration intentionally standardised for optimal operation of the LSD.

Alpine says the batteries charge from 20 to 80 per cent in less than 28 minutes at 100kW, less time than a trip to the service park for an internal combustion rally car.

Assembly process

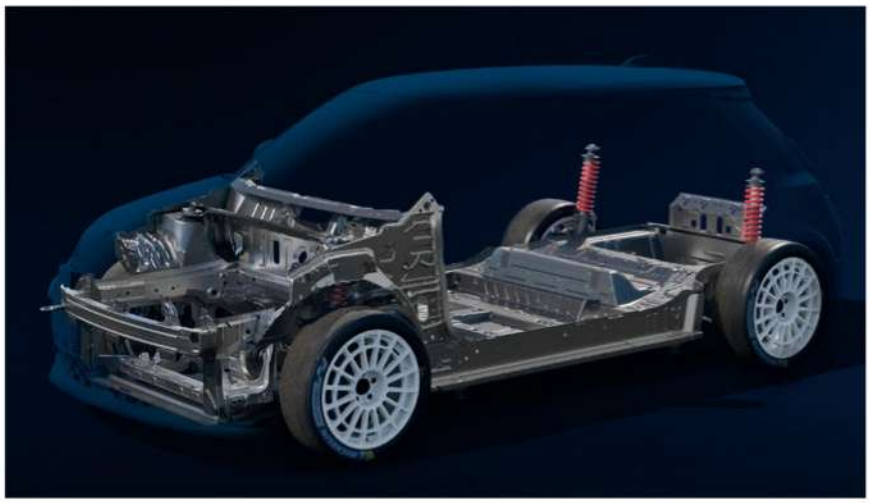
The cars are being built at Manufacture Alpine Dieppe Jean Rédélé, where a rollcage is welded to the production body structure, which in turn is reinforced to provide anchor points comparable to those of a Rally3 car. Cockpit features include a Sabelt Spine seat with 10-year homologation, six-point harness and an automatic fire suppression system. Added to this are safety technologies with a focus on education: battery monitoring and external light signals inform marshals and spectators in the event of an incident.

Lastly, Alpine has built a sound system exclusively for the A290 Rallye that, it says, 'ensures a precise and reassuring perception of the car,' depending on its speed and pressure exerted on the accelerator pedal.

The accompanying press release describes the A290 Rallye as 'an accessible and educational' motorsport tool. 'Its simple settings and standardised energy management system make it an ideal springboard for discovering, or rediscovering, rallying in the modern era, highlighting Alpine's ability to combine engineering excellence with a long-term vision.'

'This project is a genuine manifesto,' adds Bruno Famin, VP of Alpine Motorsport. 'Alpine is taking a decisive step forward in its commitment to sustainable and exciting motorsport with the A290 Rallye. We are breaking new ground, but staying true to our heritage while undeniably looking to the future. As we do every day with the road cars, we are demonstrating that electric power can also be a source of pleasure, performance and affordability in a competitive environment.'

Power comes from a 52kWh battery providing electrical energy to a single 160kW motor. Alpine says the battery can charge from 20 to 80 per cent in under 28 minutes at 100kW



Last year's FIA WRC3 runner-up, Mattéo Chatillon, has described the A290-derived chassis as a 'strong point' of the rally version, saying it is 'extremely forgiving and incredibly well-balanced, allowing to push without feeling scared'

Fast and loose

Thoughts on how better to level the playing field in motorsport

By DANNY NOWLAN

Rain is a great unpredictable factor in motorsport but, in the absence of a guaranteed storm, there are things you can do to give your car and driver a leg up on the competition and improve racing

Recently, I was watching a motorsport event that, to all intents and purposes, was effectively a spec formula, with a base case car that left a lot to be desired. Murphy's law then struck, and the weather didn't cooperate. Unsurprisingly, cars were going off the track left, right and centre, and the race result turned into a lottery. While it made for a great spectacle, clickbait and online moments, it got me thinking is this what we truly want motorsport to descend into? It's a serious question, not a flippant one, and one I feel needs to be asked. Fortunately, there is a way forward that not only honours what motorsport really is, but generates the conditions for it to happen organically.

To set the stage for this, I want to give you a quick ChassisSim history lesson. Not to illustrate how wonderful I am, but to blow apart a key motorsport myth that, in order to go fast, you need to spend a fortune.

ChassisSim has been developed on a fraction of the budget of some of its more illustrious contemporaries. This shows what can happen when you understand your first principles, you stick at it and are willing to make a few mistakes in the process of learning. That, folks, is the price of admission to the motorsport party.

Logging on

The first item we need to talk about, then, is data acquisition (another one of the great myths in this business being that using it drives up cost). To put this in perspective, **table 1** summarises what you need to log. That's it. It doesn't need to be any more fancy than that to get you 95 per cent of the way there. The budget-busting amount for all this is around $7000 (approx. £5200), give or take a few coins. Given that is a fraction of what even a mid-level team will spend on hospitality for a race weekend at events like Le Mans, that is just a drop in the ocean.

Table 1: Core data channels you need to log

Channel	Role	Frequency
Engine rpm	Engine / chassis	50Hz
Engine temperature	Engine	10Hz
Oil pressure	Engine	10Hz
Lateral acceleration	Chassis	200Hz
Vehicle speed	Chassis	50Hz
Inline acceleration	Chassis	200Hz
Vertical acceleration	Chassis	200Hz
Steering	Chassis	50Hz
Throttle	Engine / chassis	50Hz
Front brake pressure	Chassis	50Hz
Rear brake pressure	Chassis	50Hz
Gear position sensor	Chassis	10Hz
Damper position FL	Chassis	200Hz
Damper position FR	Chassis	200Hz
Damper position RL	Chassis	200Hz
Damper position RR	Chassis	200Hz
GPS altitude	Chassis	10Hz

This shows what can happen when you understand your first principles, you stick at it and are willing to make a few mistakes in the process of learning

If you really want to go overboard, **table 2** will add the finishing touches. An educated guess would put your spend at another $5000 (approx. £3720) to go all out. Granted, cars with heave and disconnected roll springs might bump that price by another $1000 (approx. £740) or so, but that's really splitting hairs.

Some of you reading this, particularly if you operate at the big end of town, might think I'm a bit full of myself. However, what I have just listed is the basis of the ChassisSim monster file that allows you to reverse engineer track, tyre and aero properties from race data, and the track record of doing this speaks for itself.

There is something much more significant at play here though. For a grand total of around $12,000 (approx. £8900), you have just given a mid-level team the firepower needed to take on the big boys. A data suite like that shown will give them the tools to figure out their tyre and aero models from their race data. All they need to do is apply a bit of smarts.

To say this approach levels the field is an understatement, and I'm genuinely curious how anyone can say it spoils the show.

Table 2: Extra channels for a full data suite

Channel	Role	Frequency
Pitot speed	Chassis	50Hz
Suspension load FL	Chassis	200Hz
Suspension load FR	Chassis	200Hz
Suspension load RL	Chassis	200Hz
Suspension load RR	Chassis	200Hz
Front laser ride height	Chassis	200Hz
Rear laser ride height	Chassis	200Hz
Internal tyre temperature FL	Chassis	10Hz
Internal tyre temperature FR	Chassis	10Hz
Internal tyre temperature RL	Chassis	10Hz
Internal tyre temperature RR	Chassis	10Hz
External tyre temperature FL	Chassis	50Hz
External tyre temperature FR	Chassis	50Hz
External tyre temperature RL	Chassis	50Hz
External tyre temperature RR	Chassis	50Hz
Yaw rate sensor	Chassis	50Hz

Making sense

The next item on the agenda is to write technical regulations that actually make sense. The big trap motorsport governing bodies have fallen into in recent times is being too prescriptive in terms of what can be done to the racecars in various series. This is put into focus when they get a bee in their bonnet about certain things. Here are some of the pearlers I've seen over the years:

- Series stuck with data acquisition systems so bad that they are virtually unusable.
- Locked spec dampers that are absolutely unfit for purpose.
- Aero balances completely out of whack with weight distribution.

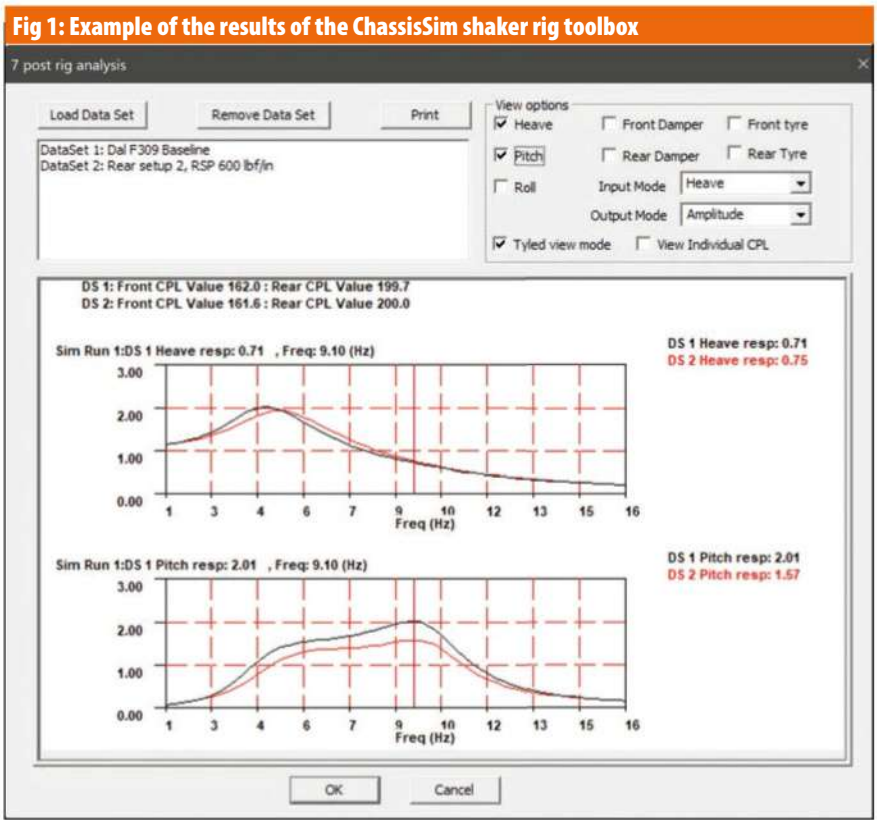
Good technical regulations clearly specify the box you are playing in, and spell it out in plain language

I could list a lot more, but that would only embarrass. Good technical regulations clearly specify the box you are playing in, and spell it out in plain language so teams can get on with the business of racing.

If they are serious about levelling the playing field in any motorsport series, regulators need to loosen up, rather than restrict, the rulebook. Damping makes for a great case study here. A study of racecar damping over the last 30 years or so proves very revealing indeed.

One of the key drivers of modern racecar damping has been the after effect of the active suspension genie being let out of the bottle. In the mid-to-late '90s and 2000s, teams didn't blink about spending a fortune on shaker rig testing and damper development. Unsurprisingly, the governing bodies then got it into their heads that this was the root of all evil. Hence the appearance of the spec damper.

Fig 1: Example of the results of the ChassisSim shaker rig toolbox



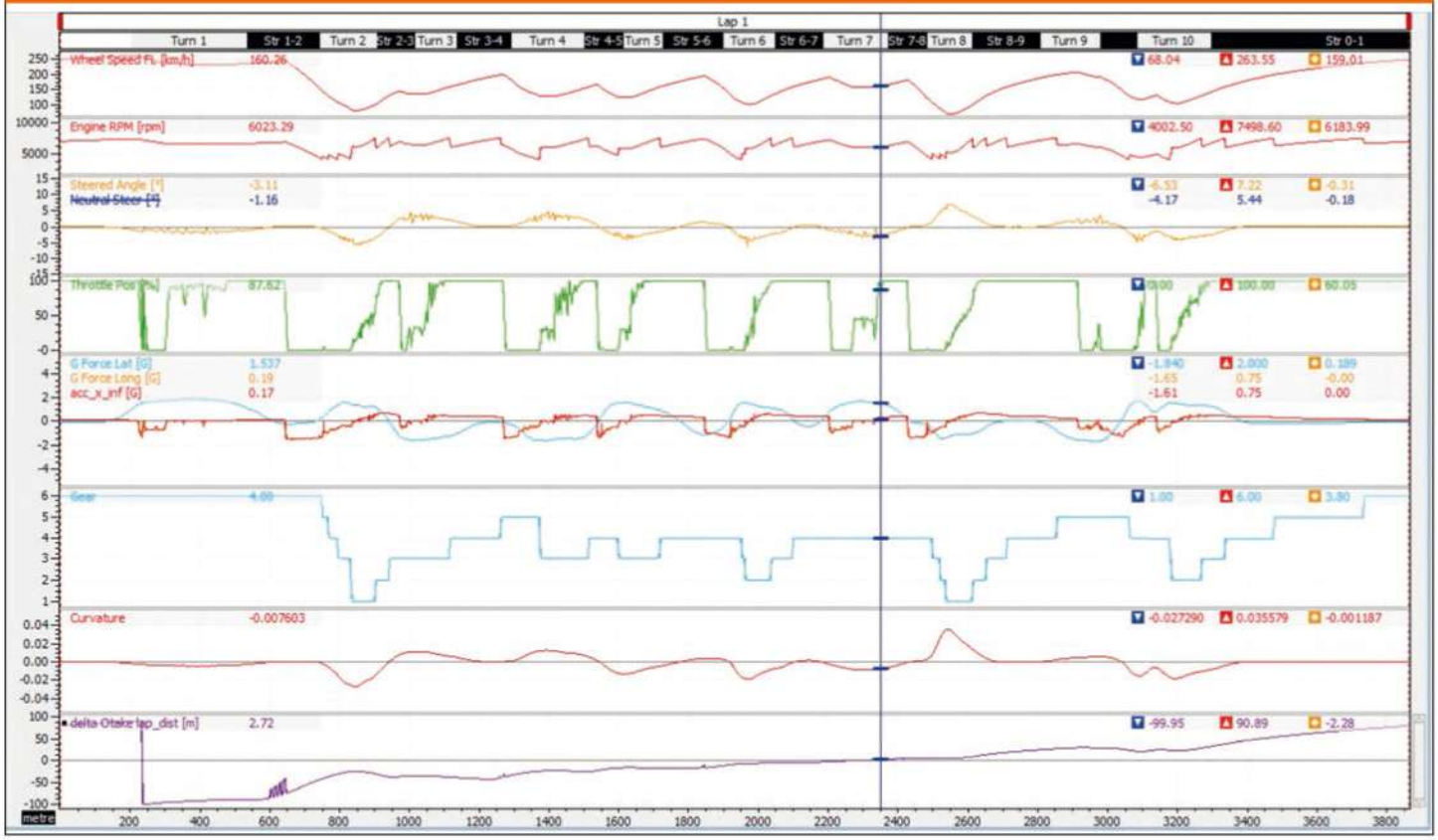
Vital tools

However, what they have missed is what came next. One of my most popular ever articles in *Racecar Engineering* is the damper workbook, which laid out in black and smudge not only what a damper curve looks like but, more importantly, what it *needed* to look like, and why. Here's where tools like the ChassisSim shaker rig toolbox, as illustrated in **figure 1**, come into play.

Virtual tools like this give the race / performance engineer cost-effective tools to figure out what is genuinely going on with racecar damping, and how to exploit it.

Every Time Attack car I have worked on has had its damper package figured out using the shaker rig toolbox, and none have ever needed to visit a rig. Additionally, companies like Penske Racing Shocks and JRi Shocks actually *want* you to play with the internals of their dampers, and make it easy

Fig 2: Simulation of two stock cars, with the overtaking car having 10 per cent more grip



for you to do so. What's needed now is for the regulatory authorities to take note.

Another huge myth motorsport, one that motorsport regulatory bodies have bought into hook, line and sinker, is that to improve the show, the cars must be the same. Absolute nonsense I say.

At this point, I'd like to refresh everyone's memory about an article I wrote a while ago on overtaking aero misconceptions. It was a comparison of two stock cars at Eastern Creek (Sydney Motorsport Park), with the chasing car having 10 per cent more grip than the target car. **Figure 2** illustrates this.

You don't need to be a rocket scientist to work out that a car with additional grip will be faster than the car it is chasing. Yet, despite this considerable performance advantage, we can see the chasing car had to cover nearly 2350m before it could overtake. In this example, that translates to nearly 60 per cent of the circuit distance. In other words, if you make all the cars the same, all you're doing is increasing the degree of difficulty in overtaking. The early years of GP3 bore this out.

Paying the price

Here is where a critical point emerges. The price you pay if you want genuine competition in motorsport is that sometimes you are going to be ahead, and sometimes you will be behind. That is the nature of the game. It amuses (and concerns) me that the moment you have a processional race, technology is always blamed. Even just with what we've discussed here, it should be plain that nothing could be further from the truth.

The price you pay if you want genuine competition in motorsport is that sometimes you are going to be ahead, and sometimes you will be behind. That is the nature of the game

Before I sign off this month, let me also state that there is a place for technical oversight, but it must be well informed. An example of this is Le Mans organiser, the ACO, banning composite material for suspension elements. Since carbon fibre doesn't deform elastically, the last thing anyone needs after a hit is a fatigue-based failure heading down the Mulsanne Straight. That was a very good, and well informed, call by the ACO, and we need more of this.

In closing, if you want genuine, organic competition in motor racing, you have to let teams off the leash. Of course, there is a place for sensible regulation, but the number one role of the regulators should be to provide a clear, well-defined set of regulations. In order to facilitate overtaking, and therefore provide a 'good show', you *need* differential performance. Only then will motorsport return to its roots as a fast, exciting sport that everyone can enjoy.

Sensibly, the ACO banned carbon composite suspension elements due to safety concerns, particularly at the speeds reached on places like the Mulsanne Straight, although for sprint series such as Formula 1 they remain commonplace

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Showtime

The CTS Show, held at Silverstone in October, brought together many of the powerhouses of UK and international motorsport

By ANDREW COTTON

The CTS Show is held at the Silverstone Wing, in the heart of Motorsport Valley and attracts the very best of exhibitors and delegates from around the world

In any pub in the UK, discussions usually turn to controversial occurrences in the world, many of which can be sorted through taking uncomplicated, obvious and, in most cases, effective decisions. Or so we all like to think. A case in point is the Motorsport Industry Association's CTS Show. No one, not even the MIA, knows what CTS stands for, and that's fine with all who attend. The important bit is that the industry body has taken the obvious route and opened a trade show in the middle of the UK's central hub of motor racing, Motorsport Valley.

The CTS Show is held in the Wing at Silverstone. Parking is free, which is helpful as Silverstone is challenging to reach by public transport. Attendees come from across the motorsport community, but also from other sectors, including marine and defence.

Within the Silverstone Technology Cluster exists an increasingly busy industrial estate housing numerous hi-tech companies, just a short walk from the circuit. The Aston Martin and Cadillac F1 teams are based within sight of the circuit, while Mercedes, Haas, Red Bull and others are a short drive away. With around 50,000 people working in the UK motor racing industry, it's no exaggeration to say the majority of the expertise is based in, or around, Silverstone.

Attendees come from across the motorsport community, but also from other sectors, including marine and defence

Business opportunity

With the investment going into the area, much of it focused on grand prix racing, the opportunities for companies to do business with these teams, or for people looking for work, is high. Having access to these companies, all in one place, in the heart of Motorsport Valley, is a spectacular opportunity.

The CTS Show is now the only motor racing-centric trade show in the UK, and the fact it sold out once again to exhibitors is testament to the fact that the country, and industry, needs such an event. It offers value to those who attend, whether exhibiting or visiting, and the numbers prove it.

Because attendance is limited to trade only, the overall number of attendees cannot hope to rival other established motorsport shows held in Europe or the United States. However, all those

A trade-only event, the CTS Show offers an invaluable opportunity for companies, teams and associated businesses to meet, talk, network and build successful working relationships

The MIA New Markets award, partnered by Fortescue Zero, was given to MGI Engineering

The MIA Business of the Year award with annual sales over £5m, partnered by Xtrac, was presented to Formula E

The MIA Teamwork award, partnered by Ridge, was presented to the McLaren Formula 1 Team

The MIA Technology & Innovation award, partnered by Ricardo, was given to Toyota Gazoo Racing

The MIA Service to the Industry award, partnered by Goodridge, was presented to the British Touring Car Championship (BTCC)

The MIA Export Achievement award, partnered by Lifeline Fire & Safety Systems, was given to Halo by Orthene

The MIA Business of the Year award with annual sales under £5m, partnered by Multimatic, was presented to DC Electronics

who attend CTS are looking to do business, and pretty much every exhibitor I spoke to declared the show a success, largely due to the quality of attendees and the conversations they were having.

The number of delegates attending has more than doubled over the last four editions of the Show, with many choosing to return as they, too, are getting what they want out of it. Indeed, nearby hotels were packed out with those who stayed for the second day, and relished the opportunity to continue networking away from the track.

The fact the awards dinner attracted around 350 delegates from the world of racing further points to the success of the format.

With such broad and topical subjects, it wasn't a surprise to see [the presentations] so well attended

Notable exhibitors this year included Jota, which was there to promote its composites business; the Toyota Hilux hydrogen fuel cell prototype, which was enormous; Speedworks and its British Touring Car; and Andretti's Formula E racer, conveniently sat by the coffee stall.

Rapid growth

From rather humble beginnings, the CTS Show has expanded and now fills three halls. Separate areas mean there is more room for displays, more space to have private conversations and more room to move around. I get the impression the plan for the future is to add more halls, rather than squeeze more into the ones that are already being used.

There were two 'speakers' corners' this year, with 38 presentations made over the course of the event. They ranged from CoByEx, which kicked things off with what lessons can be learned from the superyacht industry, through Vericut explaining the efficiency of CNC simulation, Toyota Gazoo Racing Europe on hydrogen engine technology and Catesby Tunnel on how PIV developments have proven invaluable in establishing wake effects. With such broad and topical subjects, it wasn't a surprise to see them so well attended.

Download the CTS Show guide from 2025, which lists the exhibitors, and have a look to see who you may wish to speak to at next year's show, which will be held on 14-15 October, once again at the Silverstone Wing. It's an obvious thing to do if you are in the business of motorsport.

The Telegraph

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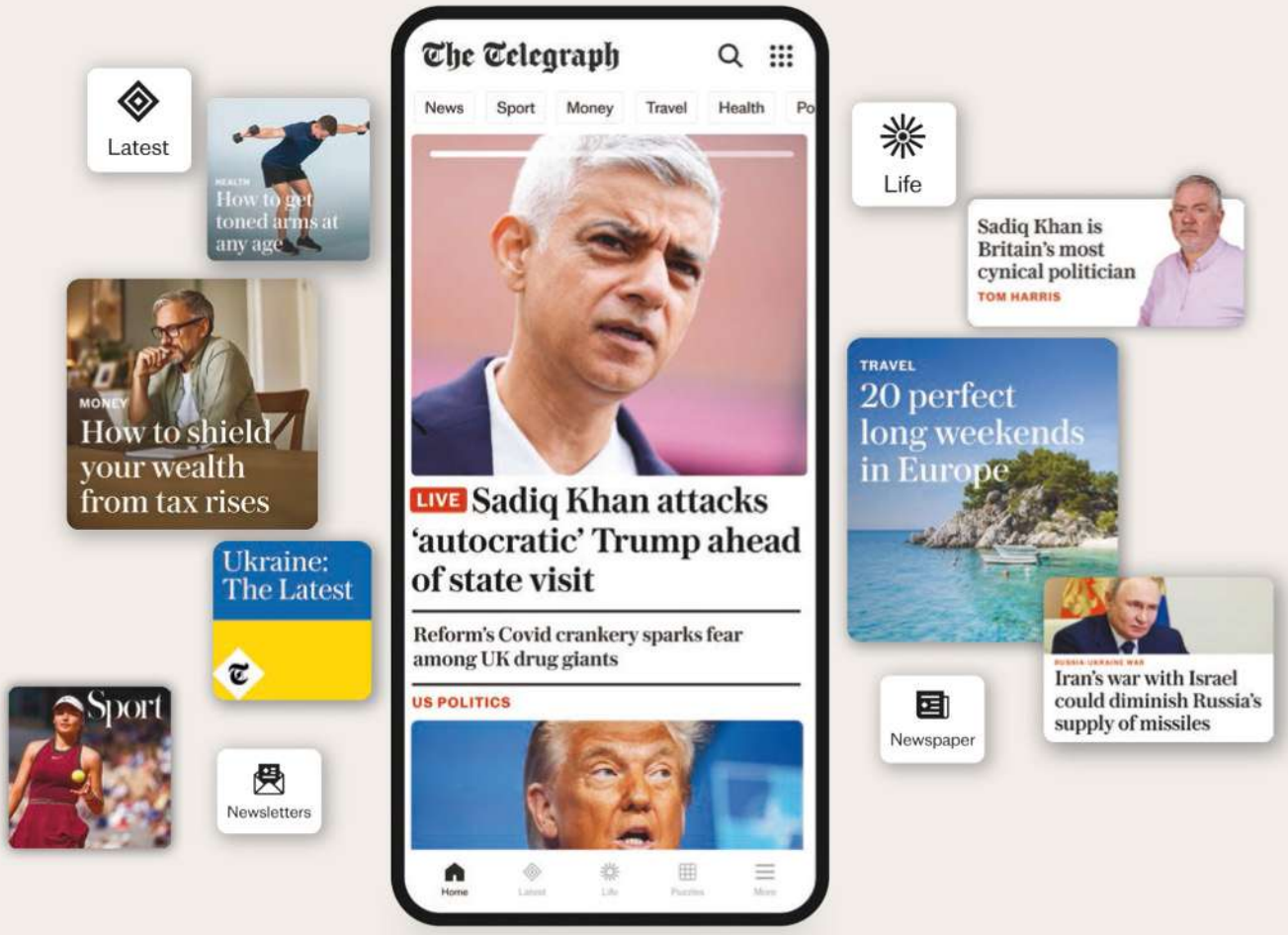

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Porsche exits WEC again

Porsche has confirmed it will withdraw from the FIA World Endurance Championship at the end of the 2025 season. It is the second time the company has done so, having stopped its LMP1 programme in 2017, before stepping back into the series with the 963 LMDh prototype in 2023.

The German manufacturer was faced with the choice of cutting at least one of its two programmes with the 963, and chose to stay in the IMSA Sportscar Championship. Leaving the WEC means it will now not race at the 24 Hours of Le Mans in 2026 with its factory team. It is widely believed that resistance against the current Balance of Performance system was one of the primary reasons for the withdrawal.

The decision means the European arm of the factory team will be disbanded, including its base in Mannheim, Germany that was set up specifically for the effort.

Porsche engineers have been snapped up by new projects coming into the WEC, including Ford, Genesis and McLaren, while drivers have also been looking for new berths.

Meanwhile, Porsche will stay in the FIA Formula E World Championship, and will continue to run the 963 in IMSA, where it won the Drivers' and Manufacturers' titles this year.

Dissatisfaction with the Balance of Performance system in the WEC is widely believed to be behind Porsche's decision to withdraw from the series

FIA opens the door to F1 power unit BoP

The FIA has made moves towards performance balancing Formula 1 powertrains following the most recent World Motor Sport Council meeting in October. Although the wording of the clarification suggests any amendments to the technical regulations are minor, and also covers the survival cell, suspension and aerodynamic components, the power unit upgrades are significant.

The change is the introduction of an Additional Development and Upgrade Opportunities (ADUO) system that will allow PU manufacturers that are 'significantly behind' their competitors to have more development opportunities. This could include allowing them to change the homologation of their power unit, to receive some cost cap relief and to be permitted additional development time using their power unit test benches.

Under the new regulations, power unit manufacturers deemed to be lagging behind their rivals could be granted additional test bench hours and allowed to change the homologation

Power units will be measured and, after races six, 12 and 18, ADUO could be allocated to a manufacturer that is deemed to be struggling. Under the current regulations that might have helped Alpine, which considers itself to be down around 30bhp compared to the other manufacturers around it.

The new cost cap relief will also be awarded to a manufacturer who is experiencing serious reliability issues.

IN BRIEF

Ginetta has announced it will be represented in the SRO GT America series with a V8-powered GTP8 as part of its expansion into the North American market. The British constructor will have a one-make class within the GT America grid. The GTP8 is powered by a 6.2-litre V8 engine that produces 390bhp. It will have an Xtrac gearbox, Bosch ABS and Alcon calipers.

The **FIA World Motor Sport Council** approved a raft of changes during a meeting chaired from the new London office by sitting president, **Mohammed Ben Sulayem**. Among the headlines were regulations governing electric drivetrains in karting, expanding on the e-karting mini regulations that were introduced in 2023. Senior e-karting classes limit voltage to 60V and position the batteries in the centre of the kart below the steering column. Electric drivetrains can be homologated by the FIA with 23kW in the Junior class, 28kW in the Senior category.

The FIA's **Appendix J** has been modified to include more energy sources, including electric, liquid fuels and hydrogen. Its aim is to 'establish common principles that ensure safety and promote the transition towards sustainable mobility'. Appendix J is a section of the International Sporting Code that provides the definition, classification and technical specification of cars used in motorsport.

The FIA's **Rally Commission** has approved the creation of an RC6 class, for Rally6 group cars. These are new entry-level cars, comprising four-seat, two-wheel drive layouts with a 1.6-litre turbocharged or 2.0-litre normally aspirated engine. They will have a power-to-weight ratio of 7.5kg/bhp, H-pattern gearbox and non-adjustable dampers.

Michelin has agreed to keep supplying its tyres to the **IMSA Sportscar Championship** for another 10 years, until the end of 2035. The French firm has been the exclusive tyre provider since 2019. That deal was extended in 2023 to 2028.

WEC considers BoP change

Succcess handicaps could be implemented in the FIA World Endurance Championship as the organisers continue to investigate ways of refining their contentious Balance of Performance system.

The possibility for a lap time handicap has been written into the 2026 sporting rules. It would come in the form of extra mass, reduced power, or both for each WEC event. Notably, handicaps would not be issued for the 24 Hours of Le Mans, where the existing BoP methodology would continue to be used.

A form of success handicap system was previously used in the last season of the LMP1 era, before BoP arrived with Hypercar in 2021, and is used in LM GT3.

The latest proposed change to the BoP system comes after Ferrari dominated the opening four races of 2025, including Le Mans. Ferrari countered by saying it had learned how to set its car up better for different tracks, but with Le Mans existing outside of the normal BoP, it was free to show its hand from the start of the season.

Other teams have complained the system is not accurate enough, and campaigned for a change. At a meeting in Paris in September, a number of proposals were put on the table, including eliminating BoP altogether, sticking with the 2025 system or adding success ballast. The LMDh manufacturers explained they had signed up to a BoP formula, so it could not be eliminated, though retaining the current system was also not a preferred option.

The proposed convergence of technology between LMH and LMDh cars should help level the playing field, but with Peugeot now building a new car for 2027 with a front hybrid system, that seems unlikely before 2028. Proposals now include common floor and brake regulations.

The FIA described the inclusion of a Hypercar success handicap in the 2026 rulebook as a 'provision', with its implementation yet to be determined

SEEN: LIGIER JS F326 FORMULA REGIONAL

Ligier Advanced Technologies recently took the wraps off its new Formula Regional car, the snappily-titled JS F326, which is built to the FIA's new second-generation regulations. It's the first Formula Regional car to be developed under Ligier's Advanced Technologies brand, following its acquisition of Mygale earlier this year.

The new carbon chassis has been produced by HP Composites, weighs 575kg and is more than 50kg lighter than the first-generation car. It features enhanced impact and intrusion resistance, a stronger roll hoop, quick release front and rear crash boxes, dual wheel tethers and an adjustable carbon seat.

The car has been developed with a 2.0-litre turbo Horse V20 engine and will feature a push-to-pass system.

'We focused on reducing steering torque and braking effort, and on optimising aerodynamics to encourage closer racing,' says Bertrand Decoster, CEO at Ligier Advanced Technologies. Check out our next issue for an in-depth look at the second-gen Formula Regional cars.

IN BRIEF

Defending winner **Mercedes** will miss the FIA GT World Cup in Macau as the German marque says it will not be ready to run with newly-mandated torque sensors. Despite running the sensors in the US and the WEC, there are no Mercedes on the 16-car entry list for the World Cup, to be held in November.

The **Japanese GT500** category, one of the few remaining classes to feature an open tyre policy, is to end the practice in 2027 as part of cost-saving measures. The class is contested by Honda, Nissan and Toyota, and currently features a tyre development battles between Bridgestone, Dunlop and Yokohama. The three manufacturers look set to continue with the Class 1 chassis regs, but tenders will be accepted to supply the rubber for the 2027 season.

IndyCar is understood to have shown the outline of its new 2028 car to teams at the end of September, despite ongoing rumours that the engine supplier and design are not yet finalised. **Acura** was tight lipped on its future participation, and is known to be considering a switch to **NASCAR**. A common block is on the cards, but the delay appears to stem from the integration of hybrid power in the car.

LMP2 manufacturers continue to work on the 2028 technical regulations, in the hope that they will be finalised by the end of this year. ORECA and Ligier won the tender to supply chassis to the class, to a capped cost, but neither has a final technical specification to start development work.

Tim Mayer, who announced he would stand against incumbent FIA president, Mohammed Ben Sulayem, has withdrawn from the race, having been unable to secure the necessary backing from South America. The rules of the election are that candidates must submit a Presidential List that includes one vice president for sport from every global region, all of whom must also be nominated for positions on the World Motor Sport Council. Mayer has vowed to continue his campaign, if not his election prospects.

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No surprises

Porsche makes the expected announcement, but at what cost?

All the talk in the paddock at Petit Le Mans, the 10-hour finale of the IMSA Sportscar Championship season at Road Atlanta, revolved around Porsche and the confirmation of its withdrawal from the FIA World Endurance Championship at the end of 2025. It is the second time the German giant has left the WEC, following its 2017 exit from LMP1, and comes as no surprise as there is a pressing need for Porsche to be seen to be saving money, even if cancelling a racing programme is not the place it should be looking.

There are some strong headwinds in the automotive industry at the moment, and they are affecting each of the big manufacturers. The market in China has not gone well recently for the Volkswagen Group, nor has the US market, with the implementation of tariffs. Even the traditionally strong European market is proving challenging, due to government demands for a reduction in emissions, coupled with the slower-than-expected take up of electric cars, following high investment. Consequently, VW Group has now cancelled some of its automotive electric programmes, and delayed the introduction of other models, including electric versions of the Porsche Boxster and Cayman.

What is unfathomable is that during this decision-making process, the Group continued its Formula E programme with Porsche, despite already having representation in the series with its Cupra brand.

Sporting investments

The rough estimate is that each programme, be it WEC, IMSA or Formula E, costs around €50m (approx. $58.3m) per year. If that sounds a lot, consider that the VW Group's investment in football (soccer) runs to hundreds of millions of Euros. According to Multi Club Ownership Insights, the company will invest €253m (approx. $293m) in the German national football team in a contract that lasts from 2019-2028, €105m in VfB Stuttgart between 2023 and 2025 and another €250m in other clubs and community initiatives. It also invests heavily in Bayern Munich and VfL Wolfsburg through various construction, sponsorship and stake purchase exercises.

The bald fact here is that Porsche gave up Le Mans. In doing so, it torched its relationship with its customers, leaving them to scramble around for their own deals. At Road Atlanta, IMSA indicated strongly that the JDC Miller team would be able to continue with this year's homologation, as an upgrade planned for next year is rumoured to be over €600,000 per kit. Two kits each for a two-car team equates to €2.4 million.

Other good news is that the Manthey Racing team will be allowed to continue running its Porsche 911 GT3 Rs in the WEC next year. When Porsche re-joined the top class, a Hypercar effort was a prerequisite for entering LMGT3.

What about Le Mans?

It's bad news for Roger Penske, who dearly wanted to win Le Mans with the Porsche 963. In Atlanta, it was made clear that even though Porsche Penske Motorsport won the IMSA title, and therefore was automatically invited to Le Mans, it would not be able to do so unless two cars raced in the full WEC. That puts the emphasis on Christian Ried's Proton Competition team, which does run a 963 in WEC. Will Penske put up the entry fee, help Ried to run a second car and therefore get the ticket to Le Mans? Probably not.

Porsche's decision is also believed to be influenced by the Balance of Performance. The company's motorsport boss, Thomas Laudenbach, has been highly critical of the system this year. At Le Mans, the second-placed car had a pretty much perfect race, but stood no chance against Ferrari, and there is nothing to suggest the situation will be any different in 2026. An introduction of success ballast instead of BoP wouldn't apply at Le Mans anyway; it would only be for the other WEC rounds. As another motorsport director put it, Le Mans is where the BoP should start, as it's the biggest prize of all. The other races should then follow on.

Porsche has chosen to walk away from the enormous marketing and media return Le Mans provides and, in doing so, from its heritage

Others have been critical of the BoP system this year. There was a plan to balance the cars to the fastest car – this year, the Ferrari 499P – but that changed, and so there is an average somewhere in the middle. That means slower cars are balanced up and faster cars balanced down. The BoP was also supposed to bring cars to within three tenths of each other, but now identical lap times are sought.

Porsche has chosen to walk away from the enormous marketing and media return Le Mans provides and, in doing so, from its heritage. That it has chosen to continue with electric racing, despite the declining road car market, and keep its US racing programme intact, is a punch to the nose of the FIA and ACO. Unfortunately, in doing that, it has also delivered a knock-out punch to itself.

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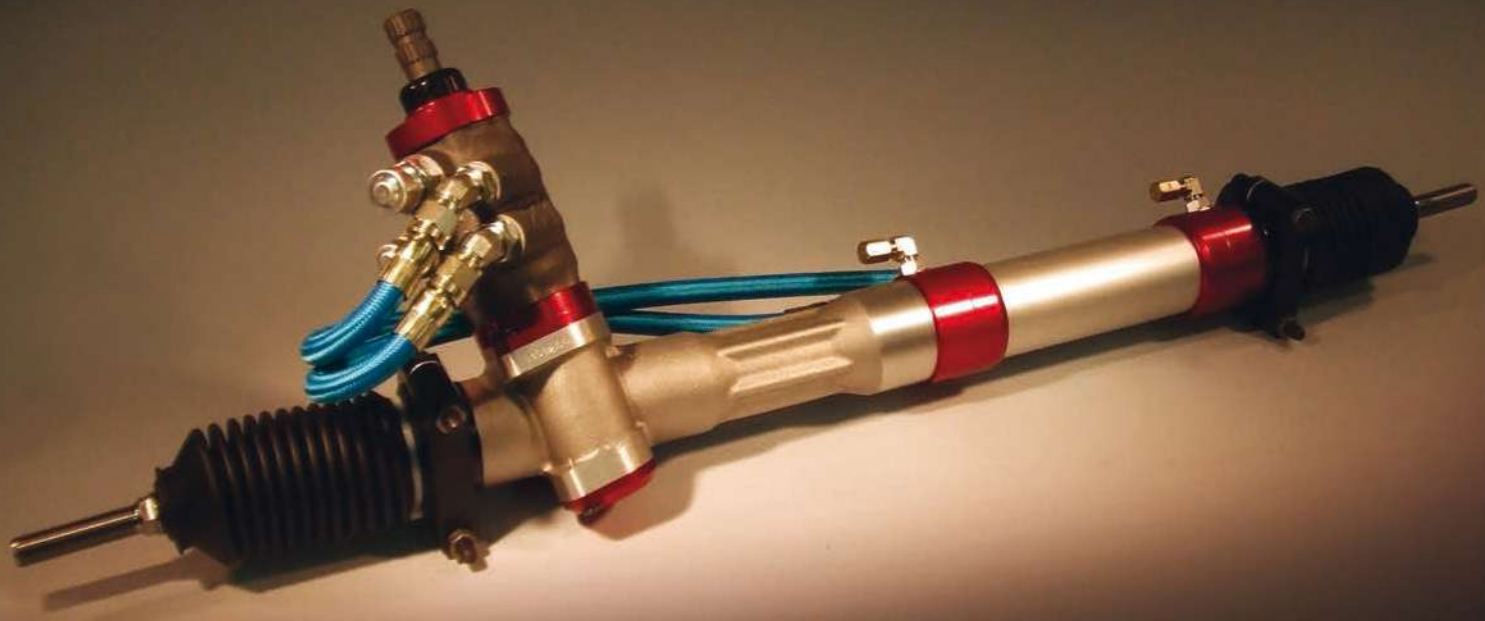

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